LIGHT THERAPEUTICS

KELLOGG

To Dr's Steele & Steele
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San Francisco College of Chiropractic

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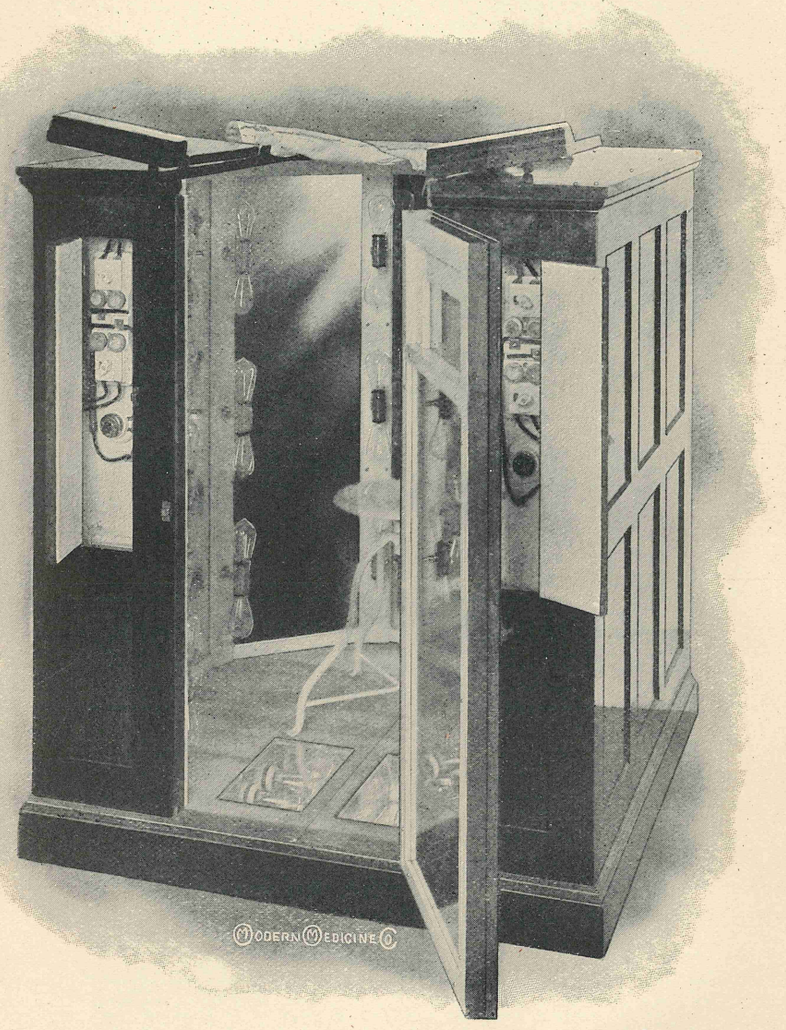

Fig. 1. The Author's Incandescent Electric Light Bath Cabinet—Latest Model.

Light Therapeutics

A Practical Manual of Phototherapy for the Student and the Practitioner

With Special Reference to the Incandescent Electric-Light Bath

San Francisco College of Chiropractic
SAN FRANCISCO, CALIF.

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PREFACE

THIS work does not profess to be an exhaustive treatise on the subject of light therapy. It is intended rather to serve as a practical manual for the clinical use of the electric-light bath in its various forms, and in its various applications, general and local.

An effort has also been made, in a small way, to correlate the electric-light bath to those other forms of rational physiotherapy which naturally and profitably associate themselves with this newest of physical curative measures.

Twenty years ago this work could not have been written. The electric bath had not yet been devised. The photophore, the electric thermophore and most of the other therapeutic methods and appliances described in this manual were not even dreamed of. Probably no non-medicinal remedy has ever found its way so rapidly into general favor as have devices for utilizing the physical properties of light in combating the inroads of disease.

The first incandescent light bath was constructed by the author in 1891. After it had been used in the treatment of some thousands of patients at the Battle Creek Sanitarium, a bath was exhibited at the Chicago Exposition in 1893. A visitor from Germany saw the bath, visited Battle Creek to become familiar with the technique of its use, and on returning to Germany began its manufacture and sale in that country. German medi-

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I.

The Physics of Light

HELIOTHERAPY, or the use of sunlight as a curative means, is one of the oldest of natural healing agents. It has been employed from the earliest times by primitive people, who were doubtless led to its use in sickness by natural instinct. Savages, and also wild animals, resort to the sun-bath for the relief of various forms of illness. It is only within the last twenty years, however, that the physiological and therapeutic effects of light derived from natural and artificial sources have been made the subject of careful scientific study. Within this period numerous investigators have devoted themselves to the study of this subject, and the extended researches that have been made have resulted in the development of a new class of therapeutic methods, principles and measures which constitute the science of phototherapy.

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THE COMPOSITION OF LIGHT

Considered from the standpoint of physics, white light is compound, consisting of three primary colors, namely, red, green and violet. By means of a prism, and by other means, a ray of light may be decomposed into seven primary and intermediate colors.

The researches of Tyndall established clearly the fact that light is not a force, but rather a mode of mo-

tion, and Clark-Maxwell and his followers have confirmed this view by showing that a ray of light is capable of exerting measurable pressure. The more slowly moving rays have a rate of motion of about 395,000,000,000,000 per second, and produce a red light, while violet light at the other end of the visible spectrum is produced by a wave movement having a velocity of 760,000,000,000,000 per second. The other colors of the visible spectrum are produced by waves of intermediate velocities.

THE INVISIBLE RAYS

Accompanying these visible rays, which are capable of making impressions upon the optic nerve, there are invisible rays produced, some by slower waves, others by waves of greater velocity. Considering the seven colors of the rainbow as constituting an octave, the whole gamut of light rays, both visible and invisible, has a range of about four octaves, of which one octave, the ultra-violet, is above the visible spectrum, and two octaves, the ultra-red, are below the red.

There are doubtless many other kinds of rays connected with the solar emanations, the properties of which the refined researches of modern physics will in due time fully reveal. Some of these are, in fact, already coming to be more or less known.

For convenience in discussing the therapeutic applications of light rays, they are divided into three classes, known respectively as heat or *thermic* rays, light or *luminous* rays, and chemical or *actinic* rays.

THERAPEUTIC LIGHT RAYS

Light treatment involves not only the use of rays of light such as appear on the ordinary spectrum, but also the ultra-violet and the ultra-red rays. The therapeutically active rays are:—

1. The chemical or actinic rays, viz.: the blue, the visible violet, and the ultra-violet; and
2. The thermic or heat rays; that is, the red and the infra-red rays.

The chemical or actinic rays and the thermic or heat rays produce different and characteristic effects. Until recently, the attention of investigators has been almost wholly directed to the effects of the actinic rays. Freund goes so far, indeed, as to exclude the thermic rays from the therapeutic field, thereby showing a lack of information concerning the exceedingly valuable curative effects of the heat rays when applied in appropriate cases with a correct technique. This work undertakes—for the first time, the author believes—to present an adequate account of the therapeutic properties of the thermic as well as the actinic rays of light.

HOW RADIANT ENERGY BECOMES HEAT

The so-called heat rays, associated with the luminous and chemical rays, are not heat in the ordinary sense, but a form of energy which is capable of being converted into heat, and which becomes heat when brought in contact with an opaque body,—that is, a substance which offers resistance to the passage of the rays. The same law holds good with this form of energy as with electricity. When a conductor through which a current of

electricity is passing is ample in size and forms what is known as a good conductor, no heat is produced; but if the conductor offers great resistance to the current, the electrical energy is transformed into heat and the temperature of the conductor rises.

Precisely the same effect is produced when thermic rays are passing through a substance which affords resistance to this form of radiation. The rays pass to the earth from the sun probably with little or no loss, but in passing through the earth's atmosphere, a portion of the energy is lost by conversion into sensible heat whereby the temperature of the air is raised. It is only when the rays reach the earth or some other opaque body that the larger portion of the radiant energy is actually converted into heat. Dolbear has calculated that the earth receives through the sunlight an amount of energy equivalent to one-fourth horsepower for each square foot of its surface, which is calculated as amounting to one forty-thousandth of the total energy thrown off by the sun for each square foot of its surface.

PROPERTIES OF THE CHEMICAL RAYS

The chemical rays, although they make little impression upon the retina, and are therefore invisible, stimulate the skin in a very remarkable manner. Their existence may be visible to the eye by the iridescence which they produce in solutions of quinin, kerosene oil, and many other substances which absorb and retain the ultraviolet rays. This fact explains the interesting experiment in which invisible writing made with a solution of quinin may be photographed as successfully as if it were made with visible ink. These invisible chemical rays are thus

able to render visible many things which would otherwise remain undiscoverable. The curious fact has been pointed out that the eruption of smallpox may through these rays be made visible in a photograph before it can be discovered by the naked eye.

The art of photography is based upon the influence of the chemical ray upon various chemical compounds. The photographer's films are extremely sensitive to the action of these rays, and hence must be carefully shielded from their influence.

SEPARATING THE RAYS

There are a number of means by which these various rays can be separated. For example, a spherical flask filled with a solution of iodin in disulphid of carbon filters out both the luminous and the chemical rays while transmitting the heat rays. Such a flask, the contents of which appear to the eye to be absolutely opaque, may be used as a burning glass, and a bit of cotton readily set on fire by focusing upon it the invisible heat rays. A solution of alum permits luminous rays to pass through it, but absorbs heat rays. The rays passing through it, although to the eye appearing wholly unchanged, are found, when allowed to fall upon a thermometer, to have lost a very large part of their heat. The skin, which is nearly impervious to luminous rays, as shown by Gadneff, transmits chemical rays to such an extent that nitrate of silver in sealed glass tubes placed under the skin of living animals is readily blackened. Prints of negatives have also been taken by the aid of chemical rays passed through the hand, forearm, and even greater

masses of living tissue. It is possible, however, to transmit only a very few of these chemical rays through the living tissues. They are almost wholly excluded by the red hemoglobin of the blood which is spread out everywhere in the capillaries.

It is only necessary to filter the light through red or yellow glass to eliminate the chemical rays and thus protect the film. The photographer utilizes this fact in the construction of his darkroom. Ordinary glass excludes the greater portion of the chemical rays. Pure quartz glass is an exception, permitting the actinic rays to pass with the others.

LIGHT FROM DIFFERENT SOURCES COMPARED

The facts above stated are true in general in relation to pure white light irrespective of its source. Thus, the light of the electric arc is essentially the same as that from the sun's rays. An ordinary arc-lamp presents a light-radiating surface of about one-tenth of an inch square. The temperature of the arc is extremely high, 6,000° F. or more, so that the energy thrown off is practically the same as that emitted by an equal area of the outer surface of the sun.

Excepting sunlight and the magnesium light, no light is so effective chemically as the electric arc light. The light of a powerful arc lamp is almost as powerful as sunlight in its action on photographic plates, and decomposes iodin salts even more energetically (Leeds).

According to the photometric investigations of Vogel, sunlight is eight to fourteen times more powerful than diffused daylight with a clear sky. The electric arc light,

1,000 candle power, at a distance of one and a half meters (five feet), is four times as powerful as diffused daylight in November with a clear sky.

The chemical effect of the arc light is greatly heightened by the use of parabolic reflectors, giving considerably more powerful effect than with lenses, and without the danger of producing burn blisters (Vogel).

Vogel found that a Shuckert reflector with 60-ampere current was sufficient to make a black photographic reproduction in fifteen seconds, while daylight in November required three minutes using the same materials, or twelve times as long. Strebel confirms this finding.

Light from an incandescent lamp contains a very small proportion of chemical rays: first, because of the comparatively low temperature at which the light is produced; second, because the incandescent film is enclosed within a globe of glass— a material which does not easily transmit chemical rays.

The great difference in the properties of the incandescent lamp and the arc lamp was well shown in an address by Sir James Dewar on the subject of "Flame," delivered before the Royal Institution of London. By careful analysis of the rays obtained from different incandescent sources, the distinguished physicist has demonstrated that of the total rays emitted by a candle flame, 98% are thermic and 2% luminous. The flame of an incandescent lamp throws off rays of which 1% to 3% only are luminous, 97% to 99% being thermic or heat rays. The arc lamp, on the other hand, gives only 90% of heat rays and 10% of light rays, or five to ten times as much as the incandescent light. The proportion of ultra-violet or chemical rays in the arc light is much greater.

IMPORTANT PRACTICAL DIFFERENCE IN PROPERTIES OF HEAT RAYS AND LUMINOUS HEAT RAYS

The great French physicist Fourtier, and afterward Professor Tyndall, showed that the dark heat rays have not the penetrating power of the rays of shorter wave length which are associated with the luminous rays. Dark heat rays, that is, the rays given off by ordinary heated bodies which are non-luminous, as from a stove or a steam coil, are not even capable of passing through ordinary glass. This is the explanation of hot-bed heat. The short-wave heat rays of the sunlight penetrate the glass and roof of the hot-bed and are absorbed by the earth. The dark heat rays which are radiated back by the earth cannot escape through the glass and so the heat accumulates in the enclosed space. Langley saw the heat rise in such a space exposed to the sun's rays to 235° F. when the outside temperature was 59° F. The atmosphere acts in the same way in relation to the earth as glass to a hot-bed because of the carbonic acid gas and water vapor which it contains.

The skin acts in a like manner in relation to the body. It permits the vigorous short-wave heat rays of the sunlight or the electric light to penetrate into the depths of the tissues, but is opaque to the dark heat rays from non-luminous sources.

These facts show at once the great difference between the therapeutic effects of fomentations and the various forms of hot air apparatus. Such appliances only heat the surface. But luminous heat rays instantly penetrate the skin and accumulate in the living tissues, raising their temperature quickly, and often to the extent of several degrees.

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II. The Physiologic Effects of Light

ALTHOUGH the influence of light upon animal and vegetable life has long been known in a general way, it is only within a comparatively short time that the subject has been studied with sufficient care to place the therapeutic utilization of light upon a sound and rational basis. The experiments of Arloing, d'Arsonval, Geisler, Paul Bert, DuBois, Graber, and especially Finsen, have contributed most important facts toward the solution of the many interesting questions connected with this subject.

When closely analyzed, these effects may be shown to belong to two classes: first, those which are due to the action of the chemical rays; and second, those which are due to the heat radiations. Practically, these effects are always more or less combined, but for clearness it is well to consider separately the two classes of effects.

EFFECTS OF THE CHEMICAL OR ACTINIC RAYS

The experiments made by Finsen and others show that chemical and thermic rays exert a decidedly different influence upon plant growth. The ultra-violet rays increase flowering, while the heat rays enhance the aroma. The action of the sunflower and other heliotropic plants in bending toward the sun shows the powerful influence of light upon life processes as manifested in plants. Plants, however, appear to be subject to damage from

excess of the chemical rays just as animals suffer sunstroke from excessive exposure to the sun.

Graber observed that the earthworm, which habitually lives in the dark, when placed in a box half of which was covered with a red glass and the other half with a violet glass, at once placed itself under the protection of the red glass, toward which it behaved the same as toward total darkness. Although we are ordinarily unconscious of the fact, there is no doubt that our life processes are influenced—to a degree far greater than we are able to appreciate or comprehend—by these subtle emanations from the sun which are known as the chemical rays. We may, indeed, be influenced by still more subtle emanations from those far-away suns which we call the fixed stars; so there may have been something more than poetry in the question of the ancient sage, "Canst thou bind the sweet influences of the Pleiades?"

A VITAL STIMULANT

The classic experiments of Finsen, some of which the writer had the opportunity to witness, having twice visited the Light Institute at Copenhagen to see the work of this ingenious investigator and become acquainted with his methods, clearly demonstrated that the actinic rays are a powerful excitant of vital activity, and hence promote to the highest degree all the processes of animal life and energy. This was a discovery of the highest importance—one which explains many facts of common observation which have heretofore been inexplicable.

The chemical ray is the source of the energy which enables the plant to elaborate in its leaves, under the influence of the sunlight, the various products necessary for its development. Vegetable structures consist, in fact, of simple elements held together in complex molecules by the chemical energy of the sunlight. Under the magic influence of these miracle-working rays, the elements found in earth, air and water are organized into groups, some comprising thousands of individual atoms, the breaking up of which, as the result of vital activity, liberates the light energy employed in holding together these organic unities, permitting the energy thus set free to manifest itself in muscular and mental efforts, and various other forms of vital work.

To be able to harness this force, to control it, and to focus it upon any desired organ or function of the body, is one of the newest and greatest triumphs of modern therapeutics.

THE EFFECTS OF LIGHT UPON PLANT LIFE

Siemens in 1880 published a detailed account of experiments for the purpose of determining the influence of light upon vegetation. The following may be deduced from his results:—

1. The electric light is efficacious in producing chlorophyl in the leaves of plants, and in promoting growth.

2. An electric center of light, equal to 1,400 candles, placed at a distance of two meters from growing plants, appeared to be equal in effect to average daylight at this season of the year (March); but more economical effects can be attained by more powerful light centers.

3. Carbonic acid and nitrogenous compounds generated in diminutive quantities in the electric arc pro-

duce no sensible deleterious effects upon plants enclosed in the same space.

4. Plants do not appear to require a period of rest during any part of the twenty-four hours of the day, but make increased and vigorous progress if subjected during the daytime to sunlight and during the night to the arc light, showing that it is a substitute for sunlight, or identical with it.

5. The radiation of heat from powerful electric arcs can be made available to counteract the effect of night frosts, and is likely to promote the setting and ripening of fruit in the open air.

6. While under the influence of electric light, plants can sustain increased stove heat without collapsing, a circumstance favorable to forcing by electric light.

In plants, chlorophyl pigment can only be formed in the light. Plants and plant parts grown in the dark have no chlorophyl, but are pale yellow in color. The yellow rays are needed for chlorophyl (Freund). The quantity of light need not be large. A light barely strong enough for the reading of large print enables sprouting plants to grow dark green (Wiesner). Plants grown in the dark have abnormally long internodes and leaf stems, but no leaf surface.

Experiments by Hervé-Mangon demonstrated that the arc light is capable of causing a development of chlorophyl and of inducing heliotropism (bending toward the source of light). Prillieux showed that the arc light is capable of promoting assimilation in plants.

THE EFFECTS OF LIGHT UPON ANIMAL LIFE

The development of many animals is dependent upon light. Frog spawn die in an opaque flask, while in a

transparent glass vessel they develop normally. Tadpoles develop more slowly in the dark than in the light (Edwards).

Auerbach observed that the protoplasm of frogs contracts under the influence of light. The white cells of frog's blood showed more and longer processes in red than in violet light. In red light they were spread out in the form of thin, hardly visible disks (Uskoff).

Finsen observed that the red corpuscles in tadpoles were contracted and became rounder under the influence of light.

Finsen also noted that the growth of the nails, hair and other epidermal tissues is encouraged by light and hindered by darkness. In his clinic he has noted that patients and nurses who work for a long time with powerful arc lights grow more hair on the arms which are much exposed to the action of light.

According to Harrington and Leaming, red light (short-length heat waves) is most favorable to the movements of the amœba, both the violet and the yellow rays impeding its movements. Englemann observed contraction of the amœba on sudden exposure to light, and rapid relaxation of the amœba when suddenly exposed to darkness.

Loeb found that the more refrangible rays encourage the growth of polypi. The red rays have the same effect as total darkness.

Flies' eggs develop more rapidly under glass admitting only the chemical rays than under glass admitting luminous or heat rays (Beclard). Maggots develop more quickly in pieces of meat exposed to the light than in meat kept in the dark (Gadneff).

The activity of the silkworm is encouraged by violet light (Guarinoni).

Light without heat causes the iris to contract in the eye of amphibia and fishes. This happens in any case, even when the retina has been removed and when the eye has been extracted a long time before (Brown-Sequard). This phenomenon is probably due to direct irritation of the muscle by light. Harless, in studying human corpses thirty hours after death, observed distinct contraction of the pupil of the eye when exposed to light. Engelmann also showed that light causes the rods and cones of the retina to shorten, while darkness lengthens them.

It is a matter of common knowledge among farmers that domestic animals develop better in well-lighted sheds than in dark ones. The same principle is recognized with reference to the development of young children.

EFFECTS OF THE ACTINIC RAYS ON THE SKIN (SOLAR ERYTHEMA)

Nearly half a century ago Charcot suggested that sunburn, or solar erythema, might be due to the ultra-violet rays. Wilde observed that a so-called sunburn is not a burn at all, since it does not appear at once but comes some hours after exposure. Finsen furnished the scientific proof that a sunburn is simply an erythema resulting from an irritation set up by the ultra-violet rays. This phenomenon, which is quite too familiar to require description, affords most positive evidence of the potency of the chemical rays. Charcot, Widmark, Bowles and others have shown that the dermatitis produced by the electric arc light (light-burn) is also due to the action of the chemical rays.

All persons are not equally sensitive to this influence of the chemical rays. Brunettes suffer less than do blondes. Negroes and other dark-skinned races are largely exempt from this unpleasant effect of the sun's rays. Lower animals as well as human beings are sensitive to the chemical rays, white cows being subject to sunburn the same as white-skinned men, while red and black cows are exempt.

Cows which are spotted red and white, or black and white, are subject to sunburn on the white spots and not on the dark spots. The curious fact has been observed that certain light-colored animals, especially cows or pigs, are more subject to sunburn after feeding on buckwheat. The reason for this has been supposed to be the development in the blood of some peculiar substance derived from the food or developed under the influence of light.

Sunburn may be produced even more easily by the arc light than by sunlight, owing to the greater richness of the arc light in chemical rays. The writer has often seen a very intense erythema induced as the result of an exposure lasting not more than five to eight minutes. Considerably longer time than this is generally required to produce sunburn by exposure to the sun's rays.

Pigmentation of the skin, or tanning, follows repeated or prolonged exposure to the influence of light, either with or without solar erythema. The cause of this darkening of the skin is the increase of pigment material through stimulation of the pigment cells of the skin. Bruecke and others have proved that the pigmentation of the skin is due to local action of the actinic rays on the skin, and not to the heat rays. In connection with solar erythema, there is doubtless also a disintegration of blood-cells and

the deposit of pigment from this source following sunburn. Sunburn usually occurs but once in persons who are taking a course of light applications, but to this rule there are occasional exceptions. The purpose of this increased pigment in the skin is protection. Even mulattoes have a much darker complexion when exposed to the sun in the summer time than in the winter season. In the South Sea Islands, when the natives are obliged to expose their naked bodies to the sun's rays for some time, they protect themselves from unpleasant effects by smearing their skins with black pigment.

Maklakow found that after a fifteen-second exposure to the powerful arc light the skin did not react at all for ten hours. After a one-minute exposure, circumscribed hyperesthesia was produced after half an hour. After two and three-fourths hours, redness of the skin was apparent. Exposures of three and one-fourth minutes were followed by redness in eleven minutes. Exposures for five and three-fourths minutes were followed by erythema in three minutes. Finsen and Moeller, after carefully investigating these results experimentally, confirmed them. It has been proved that the greater the light intensity, the sooner the appearance of the reaction and the longer its duration.

PENETRATING POWER OF DIFFERENT RAYS

Although the less refrangible red rays (short-heat waves) have by far the greatest penetrating power, the numerous experiments which have been made by Gadneff, Finsen, and others, prove that even a considerable portion of the ultra-violet rays pierce the epidermis and reach the lower layers of the skin. These penetrating

rays correspond to the third part of the ultra-violet portion of the spectrum.

Lenkei found that the blue and yellow rays penetrate the skin and living tissues to the depth of one or two centimeters (two-fifths to four-fifths inch). When there was an absence of muscular tissue some of the blue rays penetrated to a depth of over three centimeters (one and one-fifth inches). A small portion of light penetrated as far as five or six centimeters (two to two and two-fifths inches), even through the muscular layer, but this was exclusively the yellow rays. The red rays were not examined, but Lenkei believes that they have a greater penetrating power than the yellow rays. He found that five per cent of the light consists of blue rays, and eighty per cent of yellow and green rays.

Schamberg, of Philadelphia, found that an ordinary 16-candle power incandescent light with a reflector, although comparatively poor in actinic rays, will produce enough light to pass through the skin, subcutaneous tissue, muscles and mucous membrane, and affect a photographic plate in the mouth in thirty seconds, while in another test a light very rich in chemical rays (a mercury vapor light) was not able to produce any effect in five minutes.

Musck found that red, orange and yellow rays passed through his hand and affected a photographic plate in five seconds, while the blue, violet and ultra-violet rays from the same source produced no effect in ten minutes.

HISTOLOGICAL CHANGES INDUCED IN THE SKIN BY LIGHT RAYS

The histological changes occurring in the normal skin under the influence of light have been studied by Meirowsky, Schmidt and Marcuse, Schiff, Zieler, Stelwagon, Sack, MacLeod, Möller, Unna and others, who agree in general on the following findings:—

1. Pronounced dilatation of the superficial and deep cutaneous blood-vessels.
2. Migration of the leucocytes.
3. Increase in the number of active tissue cells.
4. Swelling of the collagen.
5. Thickening of the rete mucosum.
6. Hyperplasia of the epidermis and abnormal cornification.
7. Swelling of the prickle cells of the epidermis, due to parenchymatous edema. This swelling is caused by the actinic rays. When the skin is examined microscopically there seem to be small vesicles here and there, due to dilatation of the lymph spaces (MacLeod, Glebowsky).

Meirowsky states that under the stimulus of light, nuclear division of the epithelial cells takes place. Unna claims that light makes the skin dense and harder, the protoplasm being reduced to keratin.

Glebowsky made a histological study of the process of healing in cases of *lupus* under the influence of light treatment. Twenty-four hours after exposure to light, sections of the skin showed dilatation of the vessels and infiltration of the surrounding parts, with active leucocytes. The tissue spaces were dilated. Small vacuoles were clearly marked in the giant cells. These appearances increased as the number of exposures increased. The giant cells were destroyed entirely on an average after four to five exposures. The degenerative processes in the epithelioid elements were less marked as compared with those in the granulomatous cells where observations show most conclusively the value of light in assisting the tissues in the battle against invading parasites.

EFFECTS OF LIGHT UPON THE BLOOD-VESSELS

Sack has shown that the blood-vessels are the first parts affected by the light. The endothelium lining their walls swells and grows rapidly and the process ends in endarteritis, which finally obliterates the vessels. These changes are produced only when the actinic rays are applied in a greatly concentrated form and for a long period.

THE INFLUENCE OF LIGHT UPON THE CUTANEOUS CIRCULATION

Those portions of the skin which are habitually exposed to light have a much more active circulation than those parts of the skin which are covered. They are also better prepared to protect themselves against changes of temperature and show a higher degree of resistance generally. The color of skin surfaces which are habitually exposed to light is not only darker but ruddier because of the increased circulation of blood through the part. Blood-vessels of such parts are more widely dilated and more numerous than in parts protected from the action of light. When an exposure to light is of such a character as to produce erythema, the most intense cutaneous congestion results, such as might be induced by the applica-

tion of a mustard fomentation or by chemical, thermal or mechanical irritants of other sorts. The congestion produced by the chemical ray differs, however, from that induced by a fomentation in that it is remarkably lasting. One observer reports, as the result of experiments upon himself, that the increased vascularity resulting from a solar erythema was still noticeable six months later. This property of the chemical ray is of great value in therapeutics, as it affords a most admirable method of producing derivative effects whereby a state of collateral anemia may be induced in deep-lying parts. It is often in the highest degree important that such effects be secured as the only means of affording definite relief in cases of visceral congestion of various sorts, particularly in such disorders as chronic bronchitis, gastritis, hepatic congestion, intestinal catarrh, ovarian and other pelvic congestions, congestion of the spinal cord, etc. The writer has for years made use of various phototherapeutic appliances for securing these effects and with most excellent results, and believes that he was the first to point out and apply this use of solar and electric light.

THE INFLUENCE OF LIGHT UPON THE NERVOUS SYSTEM

Very strong light often produces giddiness, headache, and sometimes nausea, as the result of overstimulation of the optic nerve, doubtless through reflex action. Exposure of the head to the direct rays of the sun, and sometimes even exposure of the general skin surface, produces the same and often even more intense effects. Sunstroke affords an illustration of the powerful influence of the chemical rays upon the nervous system, the

evil effects of the sun's rays manifested in this condition being due not to heat but rather to the chemical elements of the sun's rays. When traveling in Egypt, the writer often observed natives plodding along the road in the middle of the day with their bodies almost entirely nude, but with a large shawl or scarf coiled about their heads in a huge mass for protection against the intense action of the sunlight. The black wooly hair of the negro and his thick scalp and skull afford the best possible protection against the pernicious influence of the sun's rays upon the brain. Biology teaches us that the eye is simply a modification of the skin. The optic nerve is especially subject to the luminous rays of light, while the cutaneous nerves, certain of them at least, are especially susceptible to the chemical rays. Through the influence of these rays upon the skin, strong excitant or tonic impressions are being constantly made upon the central nervous system, modifying all the nutritive processes and aiding in the maintenance of efficient activity in every vital organ.

THE INFLUENCE OF LIGHT UPON THE CUTANEOUS GLANDS

Exposure to intense light rays causes profuse perspiration. It is not necessary that the atmosphere in contact with the body should be of a high temperature; in fact, the temperature of the air about the body may be considerably below the normal body temperature. The stimulation of the perspiratory glands by the light rays excites their activity to a remarkable degree. The writer observed this in his early experiments with the electric-light bath in 1891, and later in 1894 reported a series of experiments which showed that the amount

of perspiration produced in the electric-light bath as compared with that produced in the Turkish bath was nearly double, while the time which elapsed before the appearance of perspiration was very much less in the light bath than in the Turkish bath. Professor Winternitz, of Vienna, mentioned to the writer in 1899 an observation of considerable interest in this connection. In the use of the writer's electric-light bath, which he had installed both in the Polyclinic connected with the medical department of the university and in his great medical establishment at Kaltenleutgeben, he constantly observed that perspiration began sooner on the outer portions of the thighs which were more directly exposed to the influence of the light rays than upon the inner surfaces. He also observed active perspiration in an atmosphere at a temperature much below that of the body, and in one case at a temperature as low as 65° F., in a neurasthenic patient who was particularly susceptible to the stimulus of radiant energy. A much higher temperature than this is required in the vapor bath, the hot-air bath or the Turkish bath, showing that the effect produced must be due to the stimulation of the sweat glands by the light rays.

THE INFLUENCE OF LIGHT UPON GENERAL METABOLISM

The following is quoted from the writer's chapter on Heliotherapy, in volume ix of Cohen's *System of Physiologic Therapeutics*:—

"An animal eliminates more carbon dioxid under the influence of light than when confined in the dark. This has been found to be true of hibernating animals also. Starving animals lose less weight at night than

during an equal number of hours of daylight, although kept equally quiet. Certain animals, as crabs, when painted with dark varnish, are quickly killed, although unaffected by transparent varnish (Heile).

"Eggs develop more rapidly when exposed to the influence of sunlight than when kept in the dark. This is also true of the larvæ of insects.

"Metabolism is unquestionably stimulated by the reflex action set up by the light rays impinging upon the nerve-endings of the skin and retina. Oxidation of living tissues is increased by the action of sunlight (Quincke), while in human beings, as well as in animals, less carbon-dioxid is eliminated at night than during the same number of hours of daylight, even though an equal degree of quiet be observed (Pettenkofer and Voit). Country children, who are more exposed to sunshine than those in the city, are much healthier in appearance and less subject to rickets, tuberculosis and other grave disorders. Cretinism is most frequently found in deep valleys from which the direct rays of the sun are largely excluded. Eskimo women suffer from amenorrhea during the long polar night."

THE INFLUENCE OF LIGHT ON THE BLOOD

Light increases the hemoglobin of the red cells. Hemoglobin absorbs light to a considerable degree and in a peculiar manner, as shown by the characteristic absorption bands of the spectrum.

Hertel claims that the chemical rays cause a splitting off of oxygen from the plasma of the blood and tissues much in the same way as oxygen is set free from plants under the influence of light. He believes that this process

affects both animal tissues and bacteria. Quincke demonstrated that under the influence of light the hemoglobin gives off its oxygen more quickly than in the dark. He regards this as a proof that light increases the oxidizing power of the blood, and that thereby the process of oxidation in the human body may be encouraged.

Graffenberger claims to have proved that the hemoglobin content of the red cells is diminished in the absence of light, and that prolonged darkness causes a lessening of the total quantity of the blood. Marti showed that in rats absence of light diminishes the number of red cells and the amount of hemoglobin. Strong continuous light accelerates the formation of red blood cells and also the amount of the hemoglobin content. Although Borrisow was not able to confirm this observation, he found in his experiments that dogs kept in the light, after a brief decline, gained in weight considerably, and that appetite was increased, while dogs left in darkness showed no gain in weight. According to Freund the oxyhemoglobin bands in persons examined at the close of the polar night showed signs of extension.

Finsen enveloped the body of a tadpole in moistened filter paper, and after attaching it in proper position to the stage of a microscope, exposed it to the rays of the sun. During the exposure the microscopic examination showed dilatation of the capillaries, slowing of the blood-stream and migration of the white cells, phenomena which are usually observed in simple inflammation. The red cells contracted. Uskoff found that the white cells of frog's blood showed more and longer processes in red than in violet light. In red light they were spread out in the form of thin, hardly visible discs. Hermann

claims that the leucocytes are not sensitive to light, but that the red cells usually change their shape.

Axmann found that venous blood after long exposure to the air turns a bright red when exposed to the ultra-violet rays. He believes this effect is due to the nascent ozone. He remarks that fresh and suppurating wounds behaved under the influence of the actinic rays as if they had been swabbed with hydrogen peroxide.

Penetrating luminous heat rays act not only upon the connective tissue, muscular and nerve cells with which they come in contact, but also upon the red and white blood-cells, circulating in the vessels. As these short heat rays are able to penetrate to a depth of two inches or more, it is evident that the blood circulating through the larger arterial and venous trunks is brought under their influence as well as the blood-cells moving through the smaller vessels. Through its rapid movement through the blood-vessels, the entire volume of blood in the body may be thus exposed to the stimulating influence of thermic rays within a comparatively short time. As a result, the functional activities of both the white and the red cells may be greatly stimulated. The oxidation of waste matters will thus be greatly increased, while the destruction of phagocytic bacteria and of debris resulting from accident or by disease will be greatly stimulated. Clinical experience shows that blood production is also increased. This explains the wonderful influence of the sun-bath, recognized from the most ancient times as a powerful stimulant to the vital functions.

Nerve pressure and pain are relieved by exciting the activity of the circulation through congested areas.

THE ACTION OF LIGHT RAYS UPON BACTERIA

One of the most important applications of phototherapy is based upon the destructive influence of light, or the actinic ray, upon pathogenic bacteria. The deterrent influence of sunlight upon fungi and other plants of low organization has long been known. Many parasitic fungi are easily killed by it. Some bacteria which resist strong solutions of germicides, and even prolonged boiling temperature, are quickly killed by exposure to light. Koch showed that the tubercle bacillus perishes on exposure to the sun's rays, and Kitasato demonstrated that light is destructive to the plague bacillus.

Experiments made with tetanus germs showed that they were more readily killed by direct sunlight than by a one to one-thousand solution of bichloride of mercury. The virulence of many pathogenic germs is attenuated if they are kept in the light. Diffused light acting during a long period is destructive to germs, but nearly all bacteria perish quickly when exposed to the direct influence of the sun's rays. The germicidal property of the chemical ray makes it without doubt the most powerful of nature's disinfecting agencies. If it were not for this agency, the earth would quickly become uninhabitable through the rapid development of death-dealing organisms.

Finsen found that bright sunlight killed plate cultures of bacillus prodigiosus after an hour-and-a-half exposure. It required eight to nine hours' exposure and an electric arc lamp of 25 amperes to kill a plate culture of this same bacillus at a distance of 75 c. m. from the carbon point. Finsen then tried the effect of concentrated light

upon the bacillus prodigiosus and the typhoid bacillus. He found that concentrated sunlight killed the organisms fifteen times more quickly than ordinary sunlight, and that the influence of concentrated arc light was still more powerful.

Kattenbracher in 1902 made an extended series of investigations for the purpose of determining the influence of the chemical ray upon bacteria. He employed an iron electrode lamp with a continuous current of five amperes. The distance between the object and the arc light was four inches. The light was not concentrated. He tested plate cultures of various bacilli with the following results:—

Bacillus typhi abdominalis: one second's exposure caused a luxuriant growth; three seconds' exposure diminished growth; thirty seconds' exposure diminished it still further, and a 60-second exposure prevented all growth.

Bacillus choleræ Asiaticæ: five seconds' exposure caused a diminished growth; thirty seconds' exposure, a still further diminished growth.

Bacillus tuberculosis: exposure of five, forty-five and sixty seconds showed progressively diminished growth, while a control plate showed a luxuriant growth after forty-five seconds' exposure to ordinary light.

Gonococcus: one, five and thirty seconds' exposures to the arc light caused progressively diminished growth. The control plate showed luxuriant growth after thirty seconds' exposure to ordinary light.

Streptococcus pyogenes: progressively diminished growth after exposure of two, fifteen and thirty seconds.

Bacterium coli commune: after an exposure of one

second, luxuriant growth; after five seconds, diminished growth; after sixty seconds' exposure, greatly diminished growth.

Bacillus Anthracis: after an exposure of one second, luxuriant growth; after five seconds, greatly diminished growth; after thirty seconds, complete inhibition of growth.

Buchner examined the water of the river Isar before it enters Munich, at different hours. The highest figure was obtained at 4 A. M.,—520 bacteria per cubic centimeter. The lowest figure was found at 8 P. M.,—only five bacteria per cubic centimeter, showing the result of the day's exposure to the sunlight.

Procaccini exposed to sunlight sewer water containing 300,000 to 420,000 bacteria per cubic centimeter. After a day's exposure the water was sterile.

Bacteria are readily killed by light at the surface of the soil, although twenty inches below the surface they may resist destruction for four or five months.

Downes and Blunt, Arloing, d'Arsonval, Bie, Dieudonné, Finsen, Charrin and others have demonstrated that it is the most refrangible rays of light which possess bactericidal properties, chiefly the ultra-violet rays. A few drops of anthrax culture were spread upon a gelatin plate and covered with a glass upon which had been pasted several pieces of black paper. The plates were then exposed to light. The anthrax cultures developed only under the black paper. D'Arsonval and Charrin, who experimented with the bacillus pyocyaneus, found that the chemical rays alone exerted a destructive influence upon this organism. The maximum bactericidal energy is found by experiment in the middle third of the

ultra-violet region of the spectrum. The penetrating power of the various rays is found to be in inverse proportion to their bactericidal and chemical power.

Dieudonné's observations showed that bacteria were killed in half an hour by direct sunlight, in six hours by diffused daylight, and in eight hours by an electric arc light (900 candle-power). Bang showed that the unconcentrated light from a thirty-ampere arc lamp will kill a surface layer of tubercle bacilli at a distance of thirty centimeters (twelve inches) in six minutes. The strongest bactericidal sun's rays are absorbed in the air; thus an arc lamp is found to be a valuable practical source of bactericidal rays.

Von Jansen inserted between the light rays and the bacteria a piece of skin 1.2 millimeters thick, and found that destruction of bacteria occurred in one and one-fourth hours. With skin 1.5 millimeters thick the bacteria were no longer destroyed.

There is a difference of opinion as to how the bacteria are killed. Some authorities claim that it is the direct influence of the ultra-violet rays; others hold that the destruction of bacteria is due to the changes induced in the tissues by the light.

The incandescent light has very slight effect in direct bactericidal action. Any favorable influence of incandescent light treatment on bacterial diseases must be explained by the indirect action of light rays in stimulating metabolism and in increasing leucocytosis and phagocytosis. Incandescent lamps give out very few chemically active rays.

III.

The Therapeutics of Light

WHILE of no small service in many acute affections, phototherapy renders its greatest service in the treatment of chronic maladies. Chronic diseases differ from acute maladies in the fact that they are almost universally the result of the long-continued action of morbid influences upon a weakened organism. The tonic, vitalizing, energizing influence of light, its beneficial effects upon the blood, nerves, circulation and metabolism, enable this natural therapeutic force in many cases of chronic disease to accomplish results which sometimes seem little short of miraculous.

THE INCANDESCENT LIGHT AS A CURATIVE AGENT

When the incandescent light bath was first constructed and introduced into therapeutics by the author in 1891, no adequate conception could be formed of the large place which this curative agent was destined to fill in the modern treatment of disease. Since that time the electric-light bath in various forms has found its way into almost all of the leading hospitals of the world. Hundreds of establishments, especially devoted to the employment of light as a therapeutic agent, have been opened, more particularly in Germany, and hundreds of physicians have become acquainted with the remarkable healing properties of this agent. Phototherapy or light-therapy has come to occupy a large field in therapeutics, and the number of papers, treatises and reports

dealing with the subject has multiplied to an astonishing extent. The list of the maladies which yield to the influence of light is daily increasing, although including already quite a large proportion of the most common and obstinate chronic ailments encountered in clinical practice.

Freund, of Germany, has been among the most active in developing the therapeutics of light. He employs the simple incandescent light apparatus with or without color filters in the treatment of superficial skin affections for neuralgia, myalgia, etc. The appearance of marked hyperemia and slight perspiration indicates that the treatment should be for the time suspended. Painful effusions of the joints and muscles and rheumatic pains are quickly relieved. This treatment quickens the reabsorption of serous joint exudations and dropsical accumulations. Rheumatic patients who can hardly stand before the treatment are able to walk without pain after it. But the effect is transitory, lasting only one to three hours. Complete cure is effected when the treatment is prolonged and combined with other suitable therapeutic measures.

Exposure of superficial inflammations and suppurations to powerful incandescent lamps brings strikingly good results (Freund). This treatment is especially beneficial in cases of acne vulgaris, ulcerating X-ray dermatitis, ulcerating lupus, and scrofulous neck abscesses. The duration of the exposure was thirty minutes with the diseased part as close as possible to the source of light.

Dworetzky, Kessler, Turner, Minin and others testify to the value of local treatment with the electric incan-

descent light in such painful affections as lumbago, rheumatism, cephalalgia, odontalgia, pleurisy, and pains in the chest following influenza; also in the absorption of exudates in cases of rheumatism, pleurisy, peritonitis, and gonorrheal arthritis. They even report good results in the absorption of effusions of blood, both retinal and subcutaneous and subperitoneal. Ulcerations, eczema, lupus, and other skin affections, and venereal and syphilitic effusions heal more rapidly under the influence of local incandescent light.

Rockwell reports excellent results in the relief of pain dependent on congestive and inflammatory conditions even though deep-seated, and has found the light treatment to be far more efficacious in neuritis than any other therapeutic measure.

In addition to its power to relieve high blood-pressure and pain, its thermic properties have a stimulant effect on metabolism, and its efficacy in increasing the hemoglobin-carrying power of the red cells renders the incandescent light valuable in a variety of conditions.

Schamberg thinks that light would doubtless have been more used as an auxiliary therapeutic measure had not the suddenly established reputation of the X-ray thrown the milder-acting actinic rays into the shadow. The X-ray produces important and profound changes in the cells and tissues, and when judiciously applied represents a wonderful therapeutic weapon. But it is also capable of doing great harm, even irremediable, when improperly used. On the other hand, light energy, although much slower and milder in its effect, is perfectly safe.

DERIVATIVE EFFECTS OF THE THERMIC RAYS

The writer desires especially to call attention to a therapeutic principle which so far as known has not been definitely recognized in phototherapy, namely: the therapeutic value of the effect produced upon the skin by the thermic rays of the sun, of the electric arc, the incandescent filament, and other incandescent bodies.

One of the effects of heat upon the skin is to dilate the peripheral vessels. Just how this is accomplished it may be impossible to explain with certainty. The most recent and most plausible theory is that there are in the small vessels longitudinal as well as circular fibers which by contracting serve to increase the lumen of the vessels. This effect is produced by heat applied to the skin in any manner or from any source, as by means of a hot bath, a heated object brought into contact with the skin, hot air, and heated vapor, as well as by heat in the form of radiant energy; but radiant heat is unquestionably more effective than any other form of heat in producing this dilatation of the vessels because of its greater penetrating power. The rays of energy pass through the skin and penetrate to a considerable depth, being converted into heat as they meet with resistance. A more rapid and profound effect is thus produced by the heat of the sun, or from an arc light or incandescent filament, than by thermic applications of other sorts.

PAIN INHIBITION

Another important effect produced by heat is pain inhibition. Acting through the temperature nerves, heat lessens nervous irritability and thus becomes one of our most precious means of combating pain. The same in-

hibitory influence may be employed as a means of lessening functional activity in an overacting organ. It is for this reason that we apply heat for the relief of spasm, as in colic and muscular cramp, and to produce muscular relaxation by lessening the excitability of the muscular tissue, thus lowering its "tone." The general depressing effects of heat, which are easily made manifest by a hot bath, are well known. The fomentation owes its value as a means of relieving pain in many cases to this inhibitory effect, as in neuralgias, and especially in visceral neuralgias.

The effects of heat above mentioned are, of course, temporary. The vascular dilatation rarely persists more than an hour or two after an application of heat, no matter how prolonged, and not infrequently is followed by a contraction of the vessels and very pronounced anemia. This may be due either to the chilling of the surface from evaporation of the moisture which is always present in increased amount in consequence of the stimulation of the sweat glands, or to the natural reaction which follows over-stimulation of any sort, or both influences combined. The inhibitory effect produced by heat is also more or less transient. Nevertheless, both these effects are exceedingly valuable, and the effect of solar heat and heat from other luminous sources in dilating the vessels of the skin is of immense therapeutic importance in dealing with chronic maladies.

PIGMENTATION

One of the curious effects of the daily application of heat to the skin is a coloration and very pronounced mottling, or pigmentation (Fig. 2), which always appears

after heat has been applied daily for a few weeks. The longer the application the more pronounced the effect. This effect affords positive evidence of the very pronounced and permanent dilatation of the cutaneous blood-vessels which results from thoroughgoing thermic applications.

The mottled appearance referred to differs from the tanning produced by the actinic or ultra-violet rays. The latter produce a uniform dark brownish tint, while the non-luminous heat rays and the incandescent light rays produce a mottled coloration which often endures for some weeks after the treatment has been discontinued.

SOLAR ERYTHEMA

A more intense and permanent effect upon the cutaneous blood-vessels is produced by the actinic rays of sunlight and the arc light when applied with sufficient intensity to produce so-called sunburn, or *solar erythema*. The intense reddening of the skin, which appears usually within ten or twelve hours after a sufficiently prolonged exposure to intense actinic rays, is evidence of complete relaxation of the vessels of the skin and filling of these vessels with blood to an extraordinary degree. The skin is capable of holding, when these vessels are fully distended, one-half to two-thirds of all the blood in the body.

This fact sufficiently emphasizes the difference in the volume of blood contained in an anemic skin and one in which the vessels are fully distended. The therapeutic significance of this fact lies in the influence which congestion of the skin exercises upon the blood volume of internal parts. If the blood supply of the skin is within

a short time increased from a small fraction of the total blood volume to one-third or one-half of the whole amount of blood contained in the body, it is evident that we possess in artificial congestion of the skin a method whereby we may quickly withdraw from the great vascular organs of the trunk from one-fourth to one-half of their total contents, thus affording almost instant relief to a congested liver, engorged spleen, hyperemic lungs, inflamed stomach or intestines, or congested spinal cord.

VASCULAR RELATIONS OF THE SKIN WITH INTERNAL PARTS

Careful study of the blood supply of internal organs in relation to the skin shows that the blood vessels of every important internal organ are very directly connected with the vessels of the skin, through arteries or veins, or both; so that it is possible to produce effects by means of local as well as general hyperemias of the skin, thus inducing collateral anemia of vascularly related parts. In his *Rational Hydrotherapy,* and in the chapter on Thermotherapy in Cohen's *System of Physiologic Therapeutics,* vol. ix, the author has summarized the anatomical facts respecting the vascular relations of the skin with internal parts. The liberty is taken to quote from the last-named work the following paragraphs:—

"The vessels of the brain are freely connected with those of the scalp and of the nose through the parietal foramen, the foramen cecum, the mastoid foramen, the posterior condyloid foramen, the foramen of Vesalius, the foramen ovale, the foramen lacerum medium, the carotid canal, the anterior condyloid foramen, as well as through the diploë of the cranial bones.

"The circulation of the lungs is collaterally related with that of the skin covering the arms, the chest and the upper part of the back. The pericardium and the parietal pleura of the anterior portion of the chest are collaterally related with the skin covering the anterior portion of the chest wall through the internal mammary artery.

"The parietal pleura of the posterior portion of the chest and the visceral pleura are collaterally related with the intercostal vessels. A collateral relation also exists between the bronchial arteries, the nutrient arteries of the lungs, and the intercostals, especially those of the right side. The skin covering the arms is collaterally related with the pleura of the upper and anterior portion of the chest through the subclavian artery. There also exists a collateral relation between the nutrient vessels of the lungs and the vessels covering the anterior portion of the neck through the inferior thyroid arteries. The collateral relationship existing between the vessels of the skin and of the lungs is still further extended by the connection of the bronchial veins with the azygos veins of the right side, and with the superior intercostal or the azygos veins of the left side. It is in the highest degree interesting to note these extensive communications between the pulmonary circulation and that of the cutaneous surface, all of which are of high therapeutic interest.

"The kidneys are associated with the skin covering the loins through the renal branches of the lumbar arteries.

"The vessels of the prostate in man, the uterus and ovaries in women, and the bladder in both sexes, are asso-

ciated with the cutaneous vessels overlying the sacrum, the buttocks, the perineum, the external genitals, the groins, the inner surfaces of the thighs, and the suprapubic region, these parts being chiefly supplied by branches of the internal iliac artery. These parts are also associated with the skin of the leg through the common iliac artery.

"The rectum is similarly associated with the skin covering the anal region and the perineum and that of the lower extremities.

"There is a collateral relationship, both venous and arterial, between the stomach, liver, spleen, intestines, and even the pancreas, and the skin of the trunk which overlies those deeply seated organs.

"The portal circulation communicates with the systemic circulation, thus establishing a collateral relationship with the cutaneous vessels at half a dozen or more points, especially the following: the hemorrhoidal plexus, the esophageal veins, the left renal vein, the phrenic vein at the surface of the liver, the epigastric veins at the umbilicus, the circumflex iliac vein (Treves, Schiff).

"In a similar way it may be stated that the upper half of the body is collaterally related with the lower half; a fact of which constant use is made when the lower extremities are warmed to divert blood from the head.

"The cutaneous vascular areas connected with the several viscera are roughly indicated in the accompanying diagrams (Figs. 3, 4). It should be remembered, however, that every portion of the cutaneous surface is vascularly related, at least remotely, to every internal part. It is also interesting to note that the vascular areas connected with the several internal viscera do not altogether

correspond to the reflex cutaneous areas connected with the same parts, although in the main the reflex areas and the vascular areas are practically identical. For example, the skin covering the front of the chest is of greatest importance as a means of reflexly influencing the pulmonary circulation; whereas, the cutaneous vessels of the skin covering the back of the chest are more intimately related with the vessels of the lungs than are those of the anterior surface. A most important reflex relation exists between the skin covering the lower portion of the sternum and the kidneys, whereas the principal vascular relation exists between the kidneys and the skin covering the loins.

"The portion of the body below the umbilicus is collaterally related with the head, the arms and the upper half of the trunk; and the legs are likewise in collateral relation with all parts of the body above them, especially those which occupy the pelvic cavity."

RELIEF OF VISCERAL CONGESTION

The author is obliged to confess that it is only within the last ten years that he has appreciated the importance of utilizing phototherapy as a means of producing local and general hyperemia of the skin for relief of the visceral congestion which is rarely absent in chronic disease. The pallor of the skin which is nearly always present in chronic invalids signifies not only anemia of the skin, but necessarily implies also congestion of the viscera. When the vessels of the skin are in a state of chronic spasm, especially when the skin is in that "hidebound" condition which indicates deficient development of the subcutaneous tissue, there is necessarily a surplus

of blood in the internal parts. The general muscular weakness which accompanies chronic disease prevents exercise, so that the muscles as well as the skin are anemic. The importance of this fact will be recognized when it is considered that the muscles when active are capable of holding one-half of all the blood in the body. The idle muscle contains not more than one-fourth or one-sixth as much blood as the active muscle. A pale skin and inactive muscles necessarily imply congested viscera.

This chronic congestion of vital organs necessarily results in derangement of functions, and often in change of structure. Passive congestion or stagnation of the blood in a part necessarily involves diminished oxygenation and accumulation of CO_2 and other toxic substances in the tissues. The result is partial asphyxiation and autointoxication of the congested parts through the accumulation of tissue poisons. A congested liver cannot do its duty as a bile-making and toxin-destroying viscus.

The congested stomach first manufactures an excessive quantity of highly acid gastric juice, but with a deficiency of pepsin. Sooner or later even the acid glands are worn out and hypopepsia and apepsia result. The stomach then becomes a culture chamber for microbes of various sorts. Under the influence of the toxins produced, glands degenerate, resistance is lowered, chronic gastric catarrh develops, cancer and other neoplasms appear; through absorption of the toxins formed, the resisting power of the blood is lowered; general autointoxication occurs and various cachexias develop; skin diseases of various sorts and general and local nervous disorders appear, especially the various forms of neurasthenia. Even melancholia and paresis may be traced

to the influence of toxins generated in the alimentary canal.

Similar results may follow congestion of the intestines. The resulting catarrh of the duodenum may extend into the liver and gall-bladder, giving rise to jaundice, gall-stones, hepatic abscess, pancreatic disease, appendicitis, hemorrhoids, the various forms of colitis, mesenteric tuberculosis, tubercular peritonitis, cancer of the intestines and peritoneum, and other maladies which are the outgrowth of lowered general and local vital resistance and traceable to a blood supply which has deteriorated by long retention in over-dilated vessels.

Abdominal dropsy and hepatic cirrhosis may be traced to the same cause.

Pernicious anemia and possibly other forms of anemia are also due to this condition.

Congestion of the sympathetic ganglia gives rise to abdominal pains of various sorts and a great variety of reflex pains and other symptoms, pain in the back, head, and limbs, paresthesias, neuralgias, and an almost infinite variety of mental and general nervous symptoms, vertigo, mental confusion, depression, pseudo-apoplexy, nervous irritability, nervous exhaustion, morbid fears and the *tout ensemble* of morbid phenomena presented by the vast proportion of neurasthenics and narcotics, both men and women.

REFLEX RELATIONS OF CERTAIN CUTANEOUS AREAS WITH DEEPLY SEATED ORGANS

Every portion of the cutaneous surface is in special reflex relation with some internal organ or vascular area. The most important of these reflex relationships are the following (Figs. 5, 6):

(1) The skin of the scalp, face, and back of the neck is in reflex relation with the brain. The circulation of the scalp is also immediately connected with the brain through the medium of the skull, the vessels of which anastomose with those of the scalp and those of the brain.

(2) The skin of the back is reflexly related to the centers of the spinal cord. This is also true of the entire skin surface of the trunk and limbs.

(3) The skin covering the neck is reflexly, through the spinal cord, related to the pharynx and the larynx.

(4) The upper dorsal region, the skin of the chest in front and behind, and the inner surface of the thighs, have special vasomotor reflex relation with the lungs.

(5) That portion of the chest wall overlying the heart (the precordia) is especially associated with the heart,—a fact often of priceless service.

(6) The skin covering the lower portion of the right chest is reflexly related to the liver.

(7) The skin surface of the lower left chest is associated with the spleen.

(8) The skin covering the lumbar region is reflexly associated with the uterus, ovaries, bladder, rectum, kidneys, and intestines.

(9) The skin covering the lower part of the sternum is especially associated with the kidneys.

(10) The dorsal spine is associated with the stomach, a fact which may often be made of great service in the suppression of nervous vomiting.

(11) The skin of the epigastrium has special relations with the stomach.

(12) The whole surface of the abdomen, and especially the umbilical region, is reflexly related to the intestines.

(13) The lower abdomen is associated with the uterus, bladder, colon, and rectum.

(14) The feet, and to a considerable extent the whole lower extremities, are associated with the brain, lungs, bladder, uterus, ovaries, and bowels.

(15) The skin covering the shoulders and upper portion of the back and the arms and hands is an area which is closely associated with both the cerebral and the pulmonary circulations, and may be employed in producing most useful therapeutic effects both by the reflex influence of cold applications and by the derivative effects induced by heat.

The vessels of the important viscera may be caused either to dilate or to contract by cold applications to the skin according as the application is short and intense (dilation) or long and moderate (contraction). Application of the arc light or the photophore to various skin surfaces, followed by or alternated with an application of ice or cold water or accompanied by ice rubbing at intervals, produces alternate dilatation and contraction.

EFFECTS OF THE INCANDESCENT ELECTRIC-LIGHT BATH

The incandescent electric-light bath which the author introduced into therapeutics in the early nineties has proved of intestimable value in dealing with all classes of chronic invalids. During the time which has elapsed since its first employment, this bath has been used under the author's general supervision in more than fifty thousand cases, aggregating several hundred thousand applications. At first its chief value was attributed to its elim-

inative effects, but deeper study of the subject has convinced the author that its chief value rests in its influence upon the circulation. Under the influence of the general electric-light bath, the skin is filled with blood. The stimulation of the sweat glands is incidental. The perspiration has some value through its influence upon general metabolism, but the amount of toxic matters carried out through the skin is small.

The complete filling of the skin with blood removes the disabling congestion of the liver, stomach, spleen and other internal parts. This relief is rendered more or less permanent by the fixation of the blood in the skin effected by the cold application which always follows the electric-light bath as well as other general heating measures. The active vascular dilatation following this cold application is of much longer duration than that resulting from the application of heat alone; thus a more or less durable effect is produced.

By a daily repetition of this procedure, normal conditions are gradually restored. The circulation of the skin becomes more and more active, and the amount of blood in the over-distended internal organs is diminished. The enlarged liver and enlarged spleen contract, the congested sympathetic nerve centers return to the normal state, and the vital resistance of the tissues is increased. Catarrhs of the stomach and intestines and biliary passages disappear, the digestive secretions acquire their normal characteristics, the liver, adrenals, and lymphatic glands and other poison-destroying organs resume their functions. The various symptoms of autointoxication disappear; the skin reacquires its natural elasticity and color, and the patient gradually returns to a normal state.

For producing the effects described, long applications are not necessary. Three to six minutes are ordinarily sufficient. The duration of the bath need be only enough to produce moistening of the skin from perspiration. In certain classes of cases, longer baths are needed. This is especially true of obesity, rheumatism, gout, and in diabetics who are strong and not emaciated. In these cases it is necessary to continue the bath sufficiently long to produce an elevation of temperature, so as to stimulate oxidation of the protein wastes. For this purpose the duration of the bath should be fifteen to thirty minutes, or until the temperature taken in the mouth reaches 100° to 100.5° F. It is better, when possible, to take the temperature per rectum.

THE SUN BATH AND THE ARC-LIGHT BATH

Next to the incandescent electric-light bath, the sun bath is most effective as a means of producing general hyperemia of the skin with collateral anemia of the internal viscera, and restoration of the normal balance of the circulation. The author makes use of the sun bath for this purpose at all seasons of the year, but it is found to be especially valuable in the summer, when employed by means of the outdoor gymnasium.

The arc-light bath may be used at all seasons of the year. A cabinet may be employed for this purpose with an arc light at each of the four corners (Fig. 7), or the effects desired may be produced by successive applications to different parts of the surface until the whole body has been gone over. Using two arc lights with a sheet or blanket, it is possible to improvise a very effective general arc-light bath (Fig. 8).

When it is desired to produce the more permanent effects which follow sunburn, it is better to expose circumscribed areas of the skin on successive days rather than the whole surface at once, as the patient is thus saved considerable discomfort. A sunburn involving the whole surface may produce profound disturbance in an over-nervous patient. By repeated applications the skin becomes very vascular, and intense pigmentation is produced, as is well shown in the accompanying photograph (Fig. 9). One of the subjects presented has just prepared to take his first light bath; the others have by daily exposure to the light become well tanned. In some instances the skin has been darkened to such an extent that the individual might easily be mistaken for a mulatto or an Indian if only the color of the skin were regarded.

The improved circulation of the skin which accompanies the pigmentation is always attended by relief from a multitude of disagreeable symptoms, and if these general light applications are supplemented by other indicated physiologic measures and by proper regulation of the diet and general habits of life, multitudes of cases incurable by other means may be in the course of a few months restored to excellent health.

LOCAL LIGHT APPLICATIONS

Local applications of light produce equally pronounced beneficial effects. Applications of the incandescent light may be made by means of the photophore, which consists of a metal cover enclosing one or more electric lamps. Lamps of any power desired may be employed. Ordinarily the author employs sixteen-candle-power lamps. Care must be taken to protect the edge of

the photophore if it is made of metal, so that the skin will not be burned. The author has constructed photophores of various forms for application to different parts of the body. Some of these various forms are shown in the accompanying cuts (Figs. 10, 11).

These local applications are of special value as a means of applying radiant heat to the spine, the abdomen, and the joints. This is a much more effective means than any of the various forms of hot air apparatus which have recently been so extensively sold. A higher temperature can be borne because of the absence of moisture, and more exact results can be obtained, as it is not necessary to cover the skin and there is no possibility of setting the patient's clothing on fire; and, if reasonable care is exercised, there is no danger of burning the patient. It is not necessary to confine the air in the apparatus, as the heat is not in the air, but is produced in the tissues, radiant energy being gradually converted into heat as it meets resistance in the opacity of the tissues of the skin and underlying parts. The part to which the heat is applied may be made to tolerate an intense application for a long time by frequently passing the hand over the heated surface or by using an air blast. The pressure of the hand facilitates the change of blood in the parts, thus cooling the over-heated nerves while the penetrating rays of energy still continue their work.

The author makes considerable use of both the ordinary arc light and the arc light with iron water-cooled electrodes for producing local hyperemia. By making the application long enough to sunburn the parts, the effect of a very hot fomentation may be produced, with the advantage that the beneficial effect lasts for days or

weeks, instead of only a few hours. The duration of these local applications is from four to ten minutes, according to the patient's susceptibility and the effect desired. If the patient is blond and has a thin white skin, the minimum time is indicated. Fig. 2, referred to on page 42, shows the pigmentation produced by the daily application of the photophore for a few weeks. The mottled appearance is characteristic. The pigmentation produced by the arc light is uniform in appearance.

Rikli believed that light is a food, supplying to the nervous system some subtle element which it requires. Neuens asserted that "light is the only source of life." These views are doubtless exaggerated.

The most remarkable of the therapeutic effects of light may be readily accounted for by principles which are well known to hydrotherapeutists, and without appealing to any theory of subtle, indefinable or hypothetical influence. It is not necessary to invoke the aid of any mysterious influence to find a rationale for the effects of light when employed therapeutically.

IV.

Effects of Heat and Cold, and Their Use in Therapeutic Combination

IN the use of light applications for calorific effects, the principles involved are practically the same as those which obtain in other thermic applications, as in the use of hot water, hot air, etc. The following table presents a brief summary of the effects which follow applications of heat, both general and local, irrespective of the sources:—

EFFECTS OF HEAT

GENERAL EFFECTS OF HEAT

1. Primary—excitant.
2. Secondary—depressant.
3. Short applications.—Vasodilatation, revulsion to surface.
4. Long applications.—Vasodilatation, revulsion, excitation, exhaustion.

EFFECTS OF HEAT ON THE SKIN

1. Contracts yellow elastic fibers, and relaxes white fibers.
2. Contracts smooth muscle fibers—goose-flesh.
3. Short, 110° to 130°, vasoconstriction followed by vasodilatation.
4. Long, extreme vasodilatation; later, after application, vasoconstriction.

5. Increase of perspiration and skin respiration.
6. Sensibility increased at 98°, decreased at 113°, extinct at 130°.
7. Increased heat elimination; a. vasodilatation; b. increased movement of blood; c. increased evaporation; d. increased conductivity.
8. Prepares skin for cold application.

EFFECTS OF HEAT ON THE CIRCULATION

1. First slows, then quickens pulse. (Pulse slowed and tension lowered after perspiration begins.)
2. Percutient applications raise blood-pressure.
3. Very hot immersion baths raise blood-pressure.
4. Warm general applications lower blood-pressure (98°—104° F.)

EFFECTS OF HEAT ON RESPIRATION

1. Moist, warm air increases rate and ease of respiration.
2. Hot, dry air hinders respiration.
3. Respiration slower and more superficial after hot applications.
4. CO_2 elimination increased by atmospheric temperatures below 40° and above 60°.

EFFECTS OF HEAT ON THE MUSCLES

1. Short, hot applications increase muscular energy and excitability, and lessen fatigue effects.
2. Prolonged heat lessens energy and excitability.
3. Very hot applications excite involuntary muscles.
4. Long, warm, and hot applications relax involuntary muscles.

EFFECTS OF HEAT ON THE NERVOUS SYSTEM

1. Short, very hot applications produce tonic effects, exciting brain and nerve centers.
2. Prolonged very hot applications cause general nervous excitement, followed by exhaustion.
3. Prolonged very hot applications produce toxic effects.
4. Local, very hot applications lessen nervous irritability and inhibit pain.

EFFECTS OF HEAT ON THE BLOOD

1. General applications diminish blood-count.
2. Diminish leucocytosis.
3. Diminish alkalinity.
4. Diminish viscosity.
5. Diminish hematogenesis.

EFFECTS OF HEAT ON ABSORPTION AND METABOLISM

1. Sweating baths promote absorption from alimentary canal.
2. Excite general katabolic activity.
3. Increase CO_2 production.
4. Increase nitrogen oxidation and urea.
5. Neutral baths promote anabolism.

EFFECTS OF HEAT ON THE VISCERA

1. Short, percutient local applications lessen gland activity.
2. Prolonged local applications increase glandular activity.
3. General sweating diminishes HCl.

4. Local hot applications to abdomen diminish motility of stomach and intestines.

5. Prolonged heat to abdomen congests splanchnic area.

EFFECTS OF HEAT ON HEAT PRODUCTION AND TEMPERATURE

1. Raises temperature of skin and blood.

2. General applications followed by lowered temperature.

3. Short, very hot applications diminish heat production.

4. Atmospheric temperature above 70° and below 40° increases heat production.

(At 104° in dogs, heat production increased 350%.)

The necessary use of cold water and cold air in connection with light therapy renders essential a knowledge of the physiologic effects of cold, both in general and in local applications. The following table is a summary of the effects which have been demonstrated both by clinical experience and laboratory research:—

EFFECTS OF COLD

GENERAL EFFECTS OF COLD

1. Primary—depressant.
2. Secondary—excitant.
3. Short cold applications—contraction followed by dilatation.
4. Prolonged, moderately cold applications—prolonged internal contraction.

EFFECTS OF COLD ON THE SKIN

1. Diminishes, then increases perspiration.
2. Causes pallor followed by flushing.
3. Contraction of muscular and connective tissues.
4. Lessening of sensibility and diminished reflexes.
5. The mucous membranes react the same as the skin,—though less sensitive.

EFFECTS OF COLD ON THE CIRCULATION

1. General applications quicken, then slow heart beat.
2. Increase blood-pressure.
3. Over artery, causes distal contraction.
4. Continuous over heart, depresses its action, and lowers tension.
5. Short over heart, increases force and action, then slows rate and raises tension.
6. Short cold applications anywhere increase pulse rate.
7. Cold applied to one hand contracts the vessels of the other hand.

EFFECTS OF COLD ON RESPIRATION

1. General cold douche causes quick, gasping respiration.
2. Cold, non-percutient, causes deep and slow respiration.
3. Cold increases oxidation and elimination of CO_2.

EFFECTS OF COLD ON THE MUSCLES

1. Prolonged cold lessens muscular irritability and energy of striated muscles.
2. Short cold increases irritability and energy of striated muscles.

3. Cold excites smooth fibers.

4. Cold to small area produces general goose-flesh and shivering.

5. Cold, general or local, causes shivering.

EFFECTS OF COLD ON THE NERVOUS SYSTEM

1. Applied to nerve trunk, paralyzes the parts supplied.

2. Lessens rate of transmission.

3. Prolonged cold to head lessens and may suspend mental activity.

4. Short cold to the head excites mental activity.

5. Short general applications of cold produce general excitation of the nervous system.

REFLEX EFFECTS OF COLD

1. Short, very cold with high pressure causes reflex vasodilatation.

2. Long, non-percutient cold causes reflex vasoconstriction.

3. Short cold to face and neck excites brain and heart.

4. Short cold douche to chest excites, then slows pulse.

5. Long immersion of hands in cold produces contraction of the vessels of the brain, nose and lungs.

6. Short, very cold to hands causes uterine contraction.

7. Short, very cold douche, with high pressure, to the feet, causes dilatation of the uterine vessels.

8. Immersion of the legs in cold water contracts the vessels of the lungs and kidneys.

9. Short cold to mammæ contracts uterine muscles.

10. Short, very cold to abdomen, hands and feet produces contraction of the bladder, bowels and uterus.

11. Prolonged cold to the upper dorsal region contracts the vessels of the nose, throat and lungs.

12. Ice-bag to the dorsal region contracts the vessels of the stomach.

13. Douche, lumbar region, moderate pressure (15 to 45 seconds) contracts uterine vessels.

14. Very short, cold douche to the lumbar region, with strong pressure, dilates the uterine vessels.

15. Short cold douche to the thighs causes dilatation of the uterine vessels.

16. Short cold douche to the lower sternal region excites renal activity.

EFFECTS OF COLD ON THE BLOOD

1. Short cold application increases blood-count.

2. Short cold increases oxygen absorption and gaseous exchange.

3. Short cold increases viscosity of the blood.

4. Short cold increases blood alkalinity.

5. Short cold promotes hematogenesis.

EFFECTS OF COLD ON ABSORPTION, SECRETION AND NUTRITION

1. General short cold applications increase intestinal absorption.

2. Short cold increases activity of all secreting glands.

3. Prolonged local applications at high pressure increase activity of related secreting glands.

4. Short cold quickens all vital functions and raises vital resistance.

EFFECTS OF COLD ON ANIMAL HEAT AND TEMPERATURE

1. General cold applications diminish surface temperature and the general temperature.

2. Cold spray to the soles of the feet lowers general temperature.

3. Prolonged cold to head lowers general temperature by depressing the thermogenic centers.

4. Cold to surface increases thermo-electrical phenomena.

5. Short cold increases heat production.

6. Prolonged cold increases, then decreases, heat production.

7. Cold produces thermic reaction by lowering the temperature of the skin and blood.

8. Cold produces circulatory reaction by reflex influence upon the vasomotor centers, and perhaps also by direct action upon the visceral sympathetic ganglia of the blood-vessels.

CONVECTION HEAT

When the temperature of the air is raised by contact with a heated body, its specific gravity is lessened, causing it to rise, and other air at a lower temperature is thus brought in contact with a heating surface and rises, in turn, as its temperature is raised. Thus a circulation of the air takes place, and if the air and the heated object are confined within an inclosed space, the temperature of the whole body of air will be gradually raised. If the

human body or any other object is placed within such an enclosure, the skin will be heated by contact with the heated air and through the circulation of the blood through the skin, the blood temperature will be raised and thus the temperature of the whole body will rise.

This is exactly what happens in a hot air or Turkish bath, or a vapor or Russian bath. This method of transmitting heat is known as convection, in contradistinction to heat production and heat radiation.

Convection heat has no power of penetration. It heats only the surface with which it comes in contact, although, of course, a solid body placed in a heated atmosphere gradually acquires the temperature of the medium with which it is surrounded through conduction of heat from the surface to deeper parts. Radiant heat, or rather radiant energy convertible into heat through resistance, passes in straight lines and does not stop at the surface except in case of opaque bodies, but passes through to a lesser or greater extent, according to the degree of transparency of the object with which it is in contact.

A great advantage of the electric-light bath over other forms of heating is that it permits the employment either of radiant heat alone or of radiant heat and convection heat in combination. Ordinarily the effects of the radiant heat energy alone are desired. The cabinet in which the light is administered is left sufficiently open to permit of a circulation of air without exposing the patient to draughts. This prevents the elevation of the temperature of the interior of the cabinet very much above the air of the room in which the cabinet stands.

If for any reason it is desired to utilize the heat of

convection as well as that of radiation, it is only necessary to take care to see that the cabinet is properly closed to prevent a circulation of air. When this is done the air of the cabinet will rapidly rise in temperature through contact with the heated glass bulbs, the heated inner surfaces of the cabinet walls, and the body of the patient. Transparent blue and yellow globes are much more rapidly and more highly heated than the ordinary colorless globe because of the absorption of the thermic rays. The effect of the penetrating luminous heat rays is so much more pronounced and efficient than convection heat that the use of the latter will be seldom resorted to.

RATIONALE OF THE ELECTRIC LIGHT USED AS A HEATING PROCEDURE

The electric-light bath is incomparably superior to every other means yet devised for raising the temperature of the skin or of the body in general. The thermic rays have wonderful penetrating power and reach the deep-lying tissues fully two inches below the surface. This brings the large blood-vessels, with the blood-streams passing through them, and the large nerve trunks, as well as other cutaneous branches, under the influence of the thermic rays, which must be recognized as among the most powerful of all vital stimulants. Even the brain, the spinal cord, the liver, the lungs, the heart, the lymphatic glands, the thyroid gland and other of the most important structures of the body, may be thus brought under the influence of thermic stimulation.

It is important to note the radical difference in therapeutic power between thermic applications in the form

of radiant energy and those procedures in which heat is applied by means of media, whether solid, liquid or gaseous. When heated objects such as the hot-water bag or a thermophore are brought in contact with the skin, the superficial layers of the skin are heated, and then little by little the temperature of the deeper layers is gradually raised by conduction. The process is very slow, however, and as various investigators have shown, the influence of conduction is to a very large degree counteracted by the blood and lymph circulations. That is, the deeper tissues are cooled off as rapidly as heated, the heat being conveyed away by the blood and lymph. A moist hot application such as a fomentation is a more effective heating procedure than a dry hot application, for the reason that the skin is saturated with water and thus becomes a better conductor; but the difference in effect is not great, amounting in fact to nothing more than a lengthening of the procedure in order to secure the same effects. A dry hot application, by inducing perspiration, after a time moistens the skin so that practically the effect of a moist application is obtained.

The application of heated air or vapor to the surface of the body likewise produces its effects by heating the surface only, heat being slowly conducted to the underlying layers of tissue, and thus gradually raising the body temperature; but no marked effect is produced upon the deep-lying structures—nerve trunks, viscera, etc.—unless the procedure is continued for a sufficient length of time to raise the temperature of the blood.

In the case of the electric-light bath, whether administered by means of the incandescent light or the arc light, the effect is very different indeed. When the light

rays fall upon the skin, they penetrate the deeper structures to the extent of two inches or more. This effect is instantaneous, so that the thermic stimulation of the deeper structures begins with the application and continues in full play to the end of the procedure.

Another point which seems to have been rather generally overlooked is also well worthy of notice, namely: that the highest degree of thermic stimulation through radiant heat may be produced upon the deeper structures of the body irrespective of the temperature of the skin surface or of the air surrounding the body. This is highly important for the reason that prolonged applications to the skin are depressing through the reflex effects which they evoke, whereas thermic applications to the deeper lying structures are highly stimulating. For example, it is well known that a hot application to the cutaneous surface through reflex action lessens heat production, whereas heating of the muscular structures increases heat production by stimulation of the thermogenic tissues.

Heat is the most powerful of all vital stimulants. All bodily activities are increased under its influence. It is important, then, in all cases of slow metabolism and diminished oxidation, that we should be able to stimulate the processes of tissue change and the burning of tissue wastes without bringing into operation the reflex depressing effects which are produced by heating of the skin. The skin acts thus like the glass roof of a hot-bed. It permits the passage of the luminous heat rays which accumulate in the tissues because they become dark rays, and as such cannot be transmitted by the skin except by the Down Method of conduction.

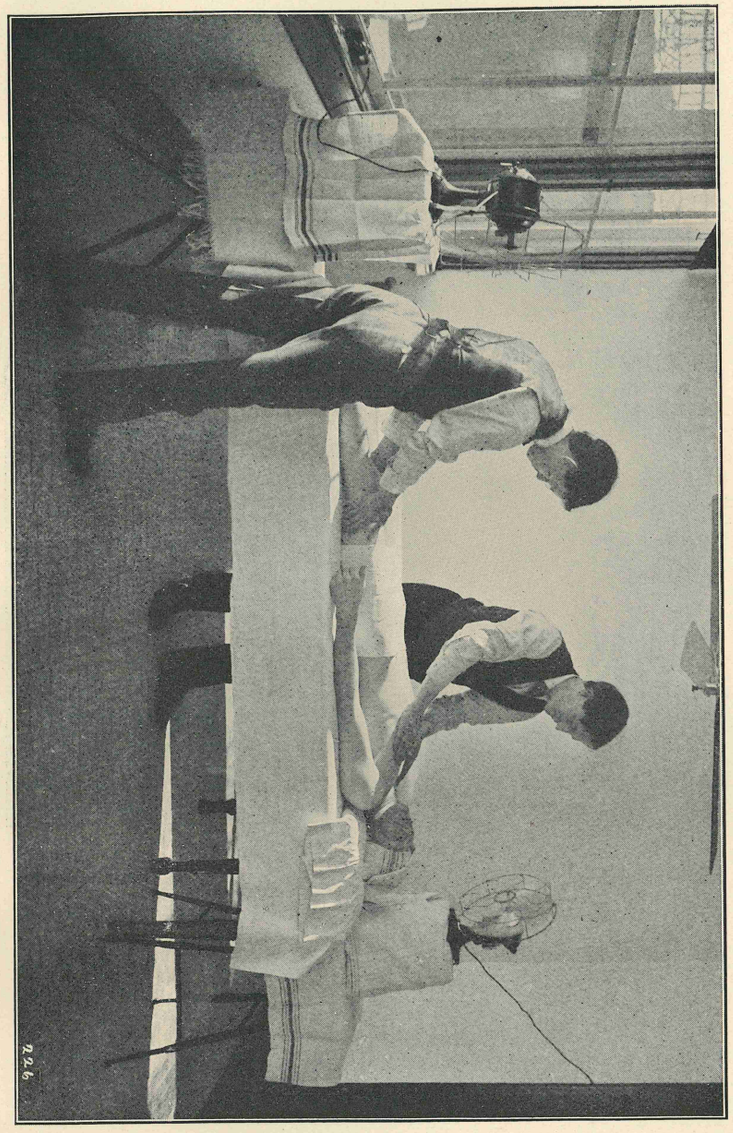

Fig. 12. The Air Blast a cooling procedure. See page 70.

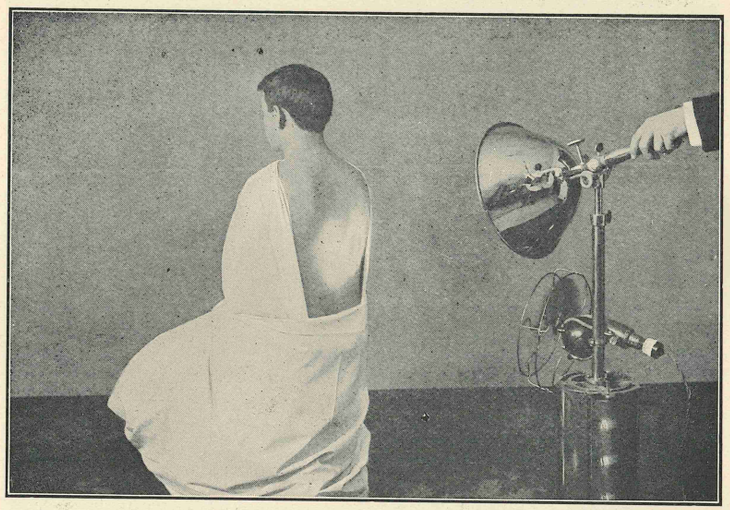

Fig. 13. The Combined Arc Light and Air Bath. See page 70.

IMPORTANCE OF COOLING THE SKIN SURFACE

The electric-light bath affords the only means by which this may be accomplished. Light rays pass through a cold skin as well as a warm one. It is important to know, however, that unless certain precautions are observed, this most desirable effect may be lost. For example, in the use of the incandescent electric-light bath cabinet, if the cabinet is closed, the air surrounding the patient will be quickly heated and so a certain amount of depression will result. The heating of the air of the cabinet is never so great, however, as in the vapor or the Turkish bath. The perspiration induced in this bath is not the result of the heating of the air about the patient. but of the direct stimulation of the sweat glands by the thermic rays which penetrate below the surface.

Thus the peculiar and excellent quality of the electric-light bath here emphasized is always in operation to a greater or less extent; but to secure the full benefit of this special property of the electric light, measures must be taken to promote the cooling of the skin surface during the application. This may be accomplished in several ways. A simple means always available is the cooling of the surface by rubbing over it at frequent intervals a piece of ice, or quickly wiping it off with a sponge or cloth dipped in cold water. This method may be used in connection either with the arc light or the photophore. This is an extremely practical and useful measure, as it may be employed under any circumstances.

THE AIR BLAST AS A COOLING PROCEDURE

Still another and very effective means of cooling is the air blast. This may be used by either of the meth-

ods illustrated in Fig. 12. As shown in Fig. 13, the fan is so placed that a strong current of air falls upon the surface to which the application is being made. The cooling effects of the air current may be enhanced by occasionally moistening the surface with a sponge or a wet cloth so as to increase the elimination of heat by evaporation. The effects obtained by this bath have been found to be most excellent.

A more convenient method of cooling the surface in connection with a general light application is the use of the electric fan in connection either with the upright or the horizontal cabinet, or the standing cabinet similar to that shown in Fig. 14. In the standing cabinet the fan is placed at the top so that the current of air strikes first upon the patient's head, the exit being at the bottom. A thermophore is placed under the patient's feet.

In the employment of these combined procedures in which the skin surface of the patient is cooled during the bath, the blast does not in the slightest degree interfere with the application. In the use of an incandescent light cabinet supplied with 16-candle-power lamps, at least a part of the lamps must be exchanged for 24 or 32-candle-power lamps. When the arc light is employed, all that is necessary, of course, is to increase the amount of current.

Experiments made with the arc light combined with the air blast and without it give the following results:—

In an application to one side of the abdomen for four minutes, the immediate effect was a very pronounced reddening of the surface. The patient experienced a very uncomfortable sensation of heat. The patient's position was then changed so as to allow the light to fall upon the

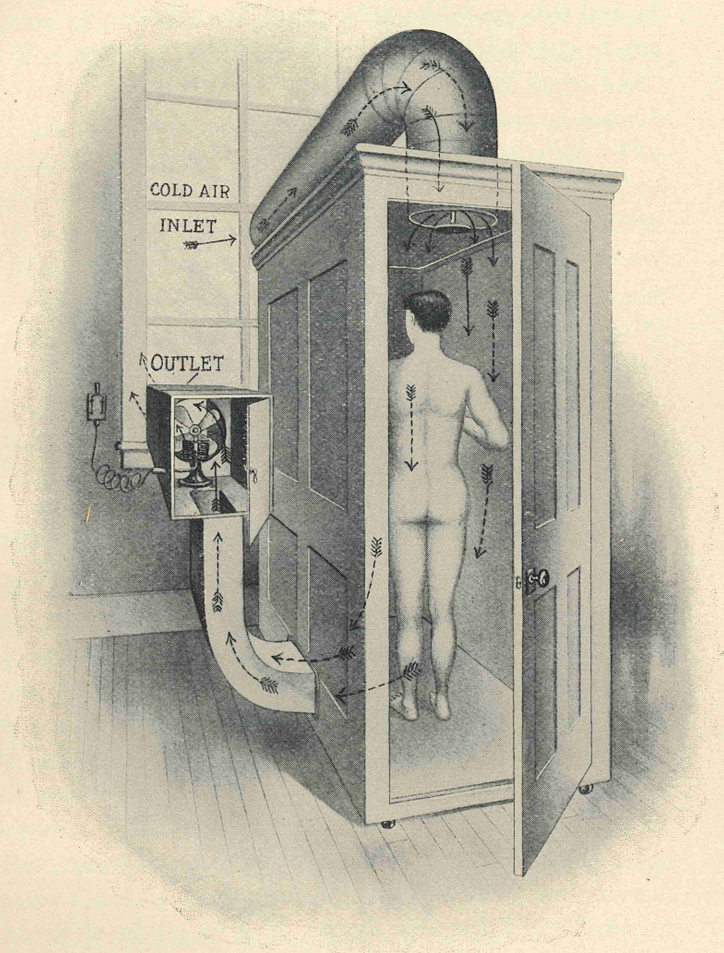

Fig. 14. Cabinet method of cooling the surface of the body with Electric Fan. See page 70.

opposite side of the abdomen. The air blast was turned on. The effect at the end of four minutes was very slight reddening of the surface and no discomfort from heat. The next day very pronounced solar erythema appeared on both sides alike. The skin was very sensitive. The effects were slightly more pronounced upon the side to which the air blast had been applied in connection with the light, than upon the other side, showing that the air light bath should be used when it is necessary to increase the intensity of the effects of the actinic ray. It is equally evident that the air blast cannot interfere with the effect of the penetrating heat rays upon the deeper tissues, since the cooling effects of the air blast must be confined entirely to the cutaneous surface.

VALUE OF COMBINED HOT AND COLD PROCEDURES

By employing cooling measures so as to prevent overheating of the skin, the intensity of the light application may be greatly increased, and thus the effects upon the deeper lying tissues may be very considerably enhanced. The writer considers the combination of skin cooling with thermic stimulation of the deep-lying structures a most important advance in the light-therapy of chronic disorders. This measure is found particularly valuable in the treatment of a large class of cases suffering from chronic toxemia as the result of intestinal autointoxication. It is of equal value in the treatment of diabetes, obesity and various diatheses and cachexias.

This procedure combines the tonic or stimulating effects of cold and heat, while eliminating the depressing influence of both. Heat depresses through the inhibitory reflexes set up as the result of the overheating of the

cutaneous nerves. Cold depresses by lowering the temperature of the blood. By the combination suggested, both of these depressing influences are eliminated, and the direct thermic stimulation of the deep structures produced by the deeply penetrating heat rays is combined with the powerful tonic reflex stimulation resulting from the cooling of the cutaneous nerves.

No possible combination of therapeutic forces could be happier than this. No physician who has witnessed the prompt and potent remedial influence of this combined procedure could fail to desire to make use of it.

By cooling the surface during a general light application, the range of application of the electric-light bath is very greatly increased, as it becomes possible to employ the bath in cases quite too feeble to endure it applied in the ordinary way.

In general, electric light applications should be preceded by water drinking. This is true even of the arc light applied to a comparatively limited area, for the reason that light applications always promote to a marked degree activity of the skin and hence diminish the volume of the blood through the loss of water. This is, of course, especially true in those applications in which vigorous perspiration is induced, as in the cabinet bath. A glass of water, either hot or cold, may be taken just before entering the bath, and if profuse perspiration has taken place, additional water should be given after the bath.

V.

Technique of Light Applications

LIGHT, whether from natural or artificial sources, like water, lends itself readily to great variation in modes of application. It differs from water, however, in the fact that its applications are of necessity practically confined to the surface. It is through its influence upon the skin glands, nerves and blood-vessels that its varied effects are chiefly produced. The various applications of light naturally fall into three classes:—

1. Applications of sunlight.
2. Applications in which the arc light is employed.
3. Applications in which the source of light is the incandescent lamp.

Sunlight is perhaps the most potent of all forms of light energy. Unfortunately, however, in most temperate climates this source of light is quite unreliable. A cloud may cover the sun at just the moment when its energy is wanted for use. Changes in the character of the atmosphere also modify in a very decided manner the intensity and activity of the solar rays. Only in the Rocky Mountain region and the southwest portion of the United States can sunlight be depended upon for systematic use. There are, however, in most parts of the United States a considerable number of sunny days which afford a convenient opportunity for the utilization of solar energy for therapeutic purposes. The following is a description

of the technique and indications in the use of sunlight for the treatment of disease:—*

THE SUN BATH (Fig. 15)

Since the clothing, or at least a considerable part of it, must be removed, it is usually necessary that a special place or apartment should be prepared for the administration of this bath. To obtain the most complete effects, the sun's rays should fall upon the surface of the body, if possible, without passing through glass, for the reason that the ultra-violet rays, which are the most active in producing therapeutic effects, are to some extent excluded by the ordinary glass. The sun-bath is best administered in an outdoor gymnasium, provided with suitable couches, a sand bank, and other appliances. Several patients of the same sex may be treated at once in such an inclosure, the demands of modesty being satisfied by the scantiest of bathing attire. Male patients commonly wear very small trunks, jock-bands, or narrow loin cloths. A very convenient protective garment may be made of a small towel by attaching at each corner a tape twelve or sixteen inches long. The towel is passed between the thighs and each end is attached to the waist by tying the tapes together in front and behind. If white or light-colored garments are worn, a considerable amount of light will reach even the covered portions of the body.

When it is desired to expose the entire skin surface,—and this is always an advantage,—tight screens may be placed about the patient in such a way as to protect him from observation while permitting the sun's rays to fall

* This account of the sunbath is borrowed from the writer's chapter on the subject in Cohen's *System of Physiologic Therapeutics*, Volume IX.

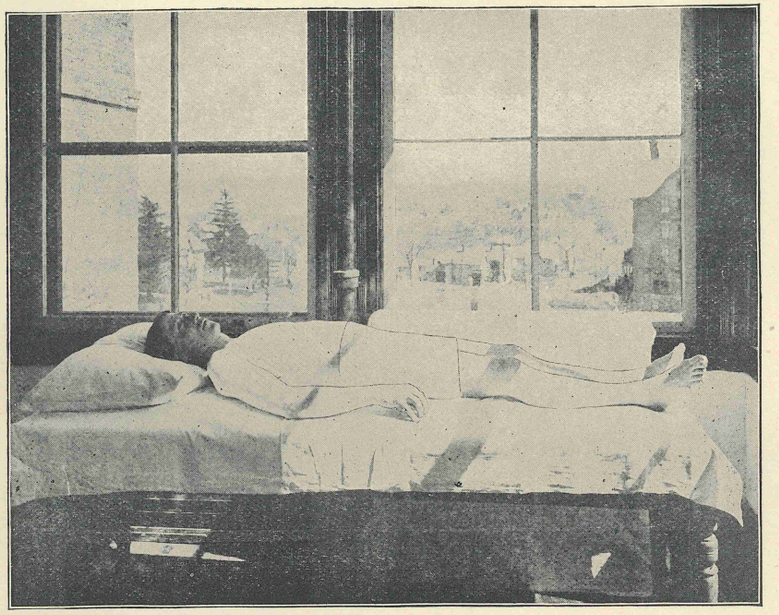

Fig. 15. The Sun Bath. See page 74.

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directly upon his uncovered body. Small, roofless cabinets may be arranged upon a flat roof. A very efficient sun-bath may be given in almost any sick-room which is so situated as to admit the sun's rays between 9 A. M. and 3 P. M., by taking out the window-sash and placing the patient naked on a bed or cot before the open window. In cold weather the patient may be placed before an unshaded window while the sun is shining.

Technique.—Either the whole surface or any desired portion of the body may be exposed to the action of the sun's rays. As a rule, it is best that the head should be protected. This may be accomplished by shading the head with a parasol, or by lightly covering it, first, with a moist towel, then with some dark-colored fabric. Exposure of the head often gives rise to nausea and other unpleasant symptoms through overexcitation of the brain and central nervous system, the natural result of the great penetrating power of the solar rays. This excitation is not necessarily due to overheating of the brain, but to the influence of the chemical or actinic ray, which is a powerful nerve stimulant.

When the whole surface of the body is to be exposed to the direct rays of the sun, it is sometimes well to protect the cerebral circulation still further by applying to the face, or to the neck and face, a cheesecloth napkin wrung out of water at 60° to 65° F. (15.5° to 18.3° C.). In the case of children and men the whole hairy scalp may be moistened as well as the face. When the exposure is continued for more than a few minutes, the wet napkin should be renewed one or more times. After a person has become accustomed to the bath, this precaution is unnecessary, and it is not often required except in

case of feeble patients, and those who are very susceptible to the stimulating effects of the sun's rays.

In the treatment of various local affections which are especially amenable to phototherapy, it is seldom necessary to limit the action of the solar rays to the affected part, as great benefit may be nearly always derived from the general improvement in metabolism induced by the application of light to the entire cutaneous surface. When localized applications are considered necessary, however, the exposure may be confined to the affected parts. I have found it convenient, in these cases, to employ white sheets or blankets as a protective, as this secures at least a partial exposure of all parts of the surface.

Feeble patients will necessarily recline during the application. More vigorous patients may walk about in an outdoor gymnasium or solarium, and may even engage in light gymnastics of some sort, or gymnastic games, with advantage, especially when it is desired to increase oxidation to as high a degree as possible, as in obesity, diabetes, and the lithemic diathesis.

The *duration* of the bath will vary considerably, according to the patient, the season of the year, and the condition of the atmosphere. A feeble patient who has not been accustomed to the sun, should, at the first sittings, be exposed, at least to a very hot sun, for not more than three minutes; longer exposure is likely to produce headache, lassitude, insomnia, and depression. Such sensitive individuals are also very likely to be sunburned by a prolonged exposure. It is well to guard against this accident, for although not serious or permanent injury is likely to result, it is very disagreeable to the patient, and may discourage further efforts in a direction essential

to recovery. The only treatment ordinarily required is the application of dry starch or a little zinc ointment; if there is considerable swelling, the cooling compress should be employed for a day or two. The sun-baths need not be interrupted; it is only necessary to cover the affected parts during the application.

In persons with light hair and blue eyes—blondes—the skin is always thin and very sensitive. The skin of persons with dark complexion and dark hair,—brunettes,—and of those who belong to the dark-skinned races, is much less susceptible to the influence of the actinic rays, and hence less likely to suffer from overdoses of sunlight. In such persons the exposure may be prolonged to half an hour or even an hour without detriment. After considerable training it is possible, in fact, for the patient to expose the greater portion of the body to the influence of the sun's rays for several hours daily, not only without ill result, but with great benefit.

When the bath is applied daily, the skin rapidly acquires a brownish tint through the increase of pigment. The protection afforded by this pigmentation not only permits a longer exposure without injury, but also seems to make a longer application necessary to insure the desired results. I have often seen patients in the outdoor gymnasium whose naturally white skins had become as dark as that of a mulatto, or a half-caste Hindoo, or South Sea Islander. This darkening of the skin indicates approximately the metabolic and therapeutic activity of the solar rays. The intensity of the sun's rays is very much greater in north temperate latitudes, during the three months from the middle of June to the middle of September, than in any other season of the year, in-

creasing as the sun approaches the summer solstice, and diminishing as it recedes.

A clear or rarefied atmosphere also increases the intensity of the sun's rays. This fact should be borne in mind in the application of the sun-bath in elevated regions. In the clear, rare atmosphere of a region elevated five thousand or more feet above the sea, the sun's rays are so intense that equal effects are obtained in half the time required at the sea-level. To produce the best results, the sun-bath should be taken daily, and the duration should rapidly be increased until the patient can bear exposure for from thirty to sixty minutes at least once a day.

A *finishing treatment* of some sort is always required at the conclusion of a sun-bath. This will differ according to the patient. In general, it is best to make a tonic hydriatic application.

The measures most serviceable in cooling and invigorating the skin, and in counteracting, by a general tonic impression, any depressing effect which may have been induced by superheating of the blood, are the cooling douche, the wet hand rub, the wet sheet rub, the shallow bath, the swimming-bath, and the alcohol rub, the application of which is later described in full.

Combined Sun-bath and Sand Bath.—The sun-bath may be advantageously combined with the sand bath for the reason that the sand being warmed by previous exposure to the sun, the whole surface is equally heated, so that perspiration, with the maximum effects of the bath, is more rapidly induced. This is particularly true in the treatment of rheumatic individuals, who are especially benefited by sun-bathing. Sufferers from chronic

rheumatism, especially those whose joints are painful, should not receive a general cold application at the conclusion of the bath, but should be sponged with tepid water, placed in a sheet, lightly wrapped, and allowed to cool off gradually. Immediately after the sun-bath the joints should be wrapped in cotton or wool and covered with mackintosh to avoid chilling by evaporation.

The Significance of Body-temperature.—The temperature of the patient should be taken before, during, and at the conclusion of the bath. The superheating which naturally results from an exposure sufficient to induce perspiration will be accompanied by an elevation of temperature amounting to one or two degrees Fahrenheit (0.5° to 1° C.). At the beginning, in the treatment of feeble patients, the temperature should be taken every ten to fifteen minutes, and the patient should be withdrawn from the bath when the body-temperature reaches 100° F. (say 38° C.).

The thermometer is a very good criterion of the effects of a bath. Patients who do not perspire readily, naturally show a higher temperature than those in whom perspiration is easily induced. Diabetics; chronic dyspeptics with dry, sallow skins, chlorotics; and persons in whom the alloxuric diathesis is strongly developed, are especially subject to overheating, and hence require careful watching. Free drinking of water is a precaution that should be resorted to in these cases. There is little danger of overheating in the case of patients who perspire readily.

An ancient method of employing the sun-bath, which is now obsolete, consisted in wrapping the patient in the skin of an animal and then exposing him to the intense

heat of the sun's rays until vigorous perspiration was induced. A favorite place of making the application was the sandy beach of the seashore. After the bath, the patient was cooled off by plunging him into the cold sea.

Physiologic Effects of the Sun-Bath.—The effects of the sun-bath include all those physiologic influences which have already been pointed out as characteristic of light. In sunlight the calorific, luminous, and actinic rays are all present in the highest degree of intensity, and the reactions induced represent the combined influence of these three powerful natural agencies. *The heat rays* give rise to an elevation of body-temperature, thus producing thermic effects practically identical with those induced by hot water, hot air, vapor, and all other means that increase the temperature of the blood, whether by causing an accumulation of heat within the body, or by preventing its escape through radiation and evaporation. The elevation of the body-temperature stimulates the heart, brain, and every other organ. Metabolic activity is increased. There is an increased production of carbonic acid, indicating an increased consumption of hydrocarbon and carbohydrates, which also occurs when the body is exposed to cold; and there is likewise an increased oxidation of protein, one of the characteristic effects of all measures which raise the temperature of the blood. These physiologic effects have an exceedingly important bearing upon the therapeutic effects and indications of the sun-bath.

As a result of the *thermic stimulation,* the cutaneous vessels are dilated, whereby, in conjunction with the increased activity of the heart, the movement of blood and consequently the metabolism throughout the whole body, are greatly accelerated; while the heating of the blood

stimulates the activity of the sweat glands, giving rise to exceedingly active perspiration. The amount of sweat produced may be increased from the normal average of one and one-half ounces in an hour to as much as two or three pounds, and even more, in an hour, especially when the patient engages in active exercise.

The *overfilling of the cutaneous vessels* diverts from the interior of the body a considerable amount of blood, since, when filled, the vessels of the skin may contain one-half to two-thirds the total quantity of blood in the body. The natural result is a draining of all the viscera; a condition allied to collateral anemia is established in the brain, liver, kidneys, stomach, spleen, and other viscera. Cerebral anemia manifests itself in drowsiness, which often causes the patient to fall into a profound slumber. This is one of the characteristic and noticeable effects of the sun's rays on the nervous system.

While the thermic rays of the sun are producing these profound effects upon the circulatory system, the *chemical rays* are acting with equal intensity upon the nervous system. That this is a real and not a fancied influence has been thoroughly established by the observations of Finsen and others who have carefully studied the subject. The phenomena of sunstroke and sunburn are also indubitable evidences of these effects, as well as of the general influence of light upon animal and vegetable life, which has already been pointed out. That sunlight is one of the most powerful tonics that can be brought to bear upon the animal organism cannot, in the light of modern researches, be doubted.

Indications.—The sun-bath is applicable in all forms of disease accompanied by defective metabolism, espe-

cially in conditions characterized by deficient oxidation, as obesity, diabetes, and the uric acid diathesis. The dry, sallow, leathery skin of chronic dyspepsia—an evidence of defective oxidation and profound autointoxication—rapidly becomes moist, lively, and velvety as the result of an hour's daily sunning. Neurasthenia, in all its forms, is materially influenced for good, the quality of the blood is improved, and all the tissue-building and energy-storing processes are stimulated. In anemia and chlorosis, the blood-making processes are encouraged, toxins are eliminated, and the spasm of the cutaneous vessels, which results in chronic visceral congestion, is rapidly relieved. In myxedema and exophthalmic goiter the sun-bath is of great value when employed with proper precautions. Care must be taken to guard the heart during hot baths of all sorts by placing an ice-bag or cold coil over the precordia. In Bright's disease, in cirrhosis of the liver and in all other forms of visceral degeneration, patients often receive surprising benefit from this simple measure, when it is employed with proper adaptation to individual needs. In such affections great care must be taken in cooling the patient after the bath. The cold mitten friction, the cold towel rub, and the wet sheet rub are excellent means of toning the skin. The cold plunge, the shallow bath, and similar measures, are unsafe in the majority of cases. In chronic rheumatism, rheumatic gout, and even in tuberculous joint disease, the sun-bath often accomplishes wonders, always affording amelioration, and sometimes aiding the patient to recover in cases which seemed quite hopeless.

Winternitz has recently called attention to the great benefit that may be derived from exposing the skin to

the sun in various cutaneous disorders, especially eczema. He covers the skin with a thin red cloth, and then exposes the parts thus protected to the influence of the full solar ray for some hours daily. Psoriasis also yields to this method. I have also met with success in several cases of chronic acne of the face and shoulders.

.Contraindications and Special Precautions.— The sun-bath is contraindicated in all febrile disorders, except in cases of chronic pulmonary disease with slight elevation of temperature. Decided febrile activity, however, should always be regarded as a counterindication to general sun-bathing, or as necessarily limiting the exposure to a very few minutes, never long enough to increase the elevation of temperature. It should be remembered that in cases of this sort the thermotactic functions of the body are disturbed, and an elevation of the temperature is very easily induced.

In cases of insomnia, great care must be taken to avoid overheating the head; the cold application following the bath should be carefully graduated, and at its conclusion a cold spray may be applied for ten or fifteen seconds to the legs and feet. In cases of rheumatism, gout, and rheumatoid arthritis, the cold application following the sun-bath must not be too intense or too prolonged. It is often better to cool a patient, especially at the beginning of a course of treatment, by a tepid shower or fan douche or the broken jet. The temperature should be from 85° to 75° F. (say, 30° to 24° C.), and the duration twenty to sixty seconds. Care must be taken to avoid allowing the stream of cold water to fall directly upon the affected joints, as this will increase the pain. In cases of cardiac disease, in which there is marked evidence of failing com-

pensation, prolonged exposure to the sun should be avoided, and the succeeding cold application should be very moderate in character, the temperature not being lower than 60° F. (say, 15° C.), and the duration from ten to twenty seconds. If the cold application is in the form of a douche, the precordial region should be avoided; the legs, the back, and the liver region receiving chief attention. In these cases, however, it is, as a rule, better to cool the patient by means of a cold towel rub or a wet sheet rub. When skin eruptions are present, very cold applications and friction must be avoided. The patient may be cooled by a prolonged rain douche at 85° to 78° F. (say, 30° to 25° C.) or a tepid bath at 90° to 85° F. (say, 32° to 30° C.) for two to six minutes. Reaction should in these cases be promoted by exercise after the bath rather than by friction.

LOCAL APPLICATIONS OF SUNLIGHT

Local applications of sunlight are commonly made with lenses or concave mirrors by which the sun's rays may be concentrated. I first employed the concentrated rays of the sun in this manner in the summer of 1883. The method was then successfully used in the treatment of a case of inveterate neuralgia of the posterior branches of the spinal nerves, and later in various other classes of cases. Experiments have shown that these concentrated rays have considerable penetrating power.

Mode of Action and Effects.—In these local applications of the concentrated solar rays, the *chemical ray* must be regarded as the active agent. The principal embarrassment which arises in the employment of concentrated light is the great intensity of the calorific rays,

which renders the application intolerable after the first few seconds. Finsen first succeeded in overcoming this difficulty. He filtered out the calorific and luminous rays by passing the solar rays through a blue solution made by dissolving copper sulphate in dilute ammonia water. The strength of the solution may be varied to suit the intensity of the sun's rays at different seasons. It should be just sufficient to reduce the heat to a degree which the skin will tolerate when the rays of the sun are brought to a focus, the purpose being to obtain the highest degree of activity of the chemical rays while reducing the action of the heat rays to the point of tolerance. The patient suffers no pain during the application, although there is sometimes intense itching. The surface under treatment reddens during the seance, and a few hours later the tissues may be slightly swollen. Twenty-four hours later a vesicle filled with clear serum usually appears. In a few days this is dry, leaving thin crusts, which are readily removed by means of dressings moistened with a solution of boracic acid. Sloughing never occurs. The effect is simply that of an intense sunburn.

Technique.—In order to increase the influence of the *chemical rays* Finsen found it expedient to compress the tissues, thus emptying the blood-vessels and rendering the skin nearly transparent, experiments having shown that the opacity of the tissues is chiefly due to the presence of the red blood-corpuscles. This compression is accomplished by means of a hollow glass disc, which is made to act as a refrigerant of the tissues by means of a constant stream of cold water passing through it. It is thus possible to concentrate the sun's rays to a degree that would otherwise be intolerable. In an emergency,

the same thing may be accomplished by a very simple though less practicable means. An ordinary lens about six inches in diameter is employed to concentrate the solar rays, which are allowed to fall upon the skin after passing through a disc of ice an inch or two in diameter, held upon the skin. The ice is pressed firmly upon the part and thus empties the blood-vessels, blanching and cooling the tissues. Figure 16 shows the devices employed by Finsen in the use of the solar rays.

The *duration* of the application is from an hour to an hour and a half. The application is confined to an area of one to three square centimeters, and is renewed daily, until the part is well cicatrized. Then another part is similarly treated.

There is no danger whatever in these local applications of the solar rays. The necessary apparatus is somewhat expensive; but the only inconvenience attending its use is the considerable length of time required.

Indications.—The actinic rays have been employed by Finsen and others in the treatment of various forms of lupus, epithelioma, and several varieties of acne, alopecia, and other maladies of the skin. The method has proved especially successful in lupus vulgaris.

The accompanying illustration (Fig. 17) shows the effect of treatment. When visiting the Light Institute of Copenhagen in 1899, I was informed that benefit had been derived in nearly all cases, and that failure had occurred only when the patient had not remained under treatment for a sufficient length of time. Note was also made of the interesting fact that better results were obtained during the summer season, when the patients were treated by the solar rays, than during the winter season, when

Fig. 16. Devices employed by Finsen in the use of the solar rays.
See page 86.

Fig. 17. Before and after treatment by the Finsen rays.
See page 86.

the treatment was administered indoors by the aid of the arc light; this difference is probably due to the tonic effects of the general exposure to the sun.

The treatment of lupus by this method must be carried out with great perseverance. Finsen states that his patients remain under treatment, on an average, for about four and one-half months. In some cases two or three applications effect a cure, while in other cases in which the disease covers a considerable area a long time is required, since in many cases the applications must be repeatedly made to each part before a cure is effected.

It is well to note that the cure is not effected by destruction of the tissues, but by destruction of the parasitic elements upon which the disease depends, and a quickening of the vital activities of the tissues, whereby their power of defense is increased.

THE ARC LIGHT

The rays of the arc light may be applied either in diffuse or concentrated form to any portion of the body's surface. Its largest use is probably as a local application or as a general application in the arc-light bath.

REQUISITES

The first requisite is a good arc light, conveniently arranged for therapeutic use. After examining all the therapeutic arc lamps offered on the market in this country and Europe, and finding all more or less objectionable because of inconvenience in use or unreasonably high price, the author had constructed under his supervision a lamp which, after several years of service in the Battle

Creek Sanitarium, in hundreds of other sanitariums and hospitals, and in the offices of private physicians, has proved to be eminently satisfactory. The latest model of this lamp (Solar Therapeutic Arc Lamp) is shown in Fig. 18.

TECHNIQUE

The application must be made, of course, to the uncovered skin of the patient. The ordinary clothing of the patient may be loosened and arranged in such a way as to expose the part to which the application is to be made, or the patient may be undressed and covered with sheet and blankets. When the application is made to a large surface, it is always better that the patient should be undressed, especially when the treatment is to be prolonged, as more or less perspiration not infrequently attends the application, and this requires a general cooling measure of some sort to prevent the patient from taking cold afterward.

Care should be taken to maintain the temperature of the room at about 70° F., so that the tendency to perspire shall not be unduly encouraged. The patient may be seated in front of the lamp, or may lie upon a bed or couch.

The Solar Therapeutic Lamp is mounted upon a light but solid and easily portable stand, and is also provided with means of adjustment so that it may be readily adapted to the individual case, both as regards position and strength of current. It is, of course, more economical to place the patient as near the lamp as is convenient, as this will utilize the rays more economically and so prevent a waste of current.

After the lamp has been properly adjusted so that the rays fall upon the area to which the application is to be made, the current is thrown on by closing the switch, the rheostat being adjusted so as to regulate the current at minimum intensity. The current is then rapidly increased to the degree desired. Care is taken to note the moment of the beginning of the application so that the seance may be timed to meet the needs of the individual case.

It is important to warn patients who are unacquainted with the application that solar erythema is a possible consequence. This is especially true in relation to very light-haired persons whose skins contain little pigment and hence are very susceptible to the influence of the actinic rays, particularly when the application is to be prolonged more than three or four minutes and when the light has a considerable degree of intensity.

The duration and intensity of the application may vary from a very short seance of one or two minutes, barely sufficient to produce a slight reddening of the surface, to an exposure of half an hour. These long seances will, however, be applied only in cases in which the patient's skin has become accustomed to exposure to the light, so that a sufficient amount of pigment matter has been developed to protect the tissues from injury, and in cases in which it is desired to produce a decided erythema for derivative effects, as when the purpose is to relieve some deep-seated pain or internal congestion.

In general, the full, unmodified rays of light are of most service and should be employed, the red or blue screen being used only when it is desired to eliminate as much as possible the chemical rays on the one hand and

the heat rays on the other. The effect of the arc light may also be modified by combination with a cool-air blast, as has been explained elsewhere.

When it is necessary to restrict the light to a small area, the surface outside of the part to be treated should be protected from the influence of the light by means of dark or black cloth or paper. When the patient is facing the arc light, the eyes should always be protected by means of smoked glasses. The eyes are very susceptible to the influence of the chemical rays.

The arc light is applicable to a great number of morbid conditions, especially when combined with proper hydratic measures.

THE ARC-CABINET BATH

A very effective general light bath may be given by means of a single arc light and a portable cabinet similar to the vapor bath cabinet in popular use. The reflector of the arc lamp is placed at an opening made for this purpose in the cabinet. The patient, by turning his body, may receive the rays upon all sides, and by tilting the lamp the lower part of the body may easily be reached. By using two arc lamps the desired effects may be secured more quickly than with one lamp.

AN IMPROVISED ARC-LIGHT BATH

By the aid of two arc lights a very satisfactory arc-light bath may be improvised. The patient is seated upon a low stool, and an arc light is placed opposite the center of the trunk in front and another behind, opposite the center of the back. Two sheets are adjusted in such a manner as to cover all with the exception of the patient's

head. (Fig. 8.) By means of this improvised arc-light bath, as efficient applications may be made as by the aid of the most expensive cabinet, and the effects are much better than those obtained from cabinets arranged with a single arc light.

LOCAL APPLICATIONS OF THE ARC-LIGHT

TECHNIQUE OF LOCAL APPLICATIONS

When it is desired to produce a powerful revulsive effect, ice should be rubbed over the surface at the completion of the application. A most intense revulsive effect may be induced by rapidly going over the surface with a piece of ice every minute or two during the application of the light.

It is always important to take great care that the surface treated is thoroughly dried after the application of cool water, alcohol or ice at the conclusion of the treatment.

ARC LIGHT TO THE SPINE

The skin of the back is supplied with nerves which have their origin near the different spinal centers. This portion of the body is consequently one of the most important to which applications can be made, and through applications to this circumscribed area effects may be induced to every organ of the body, often the most distant parts.

With the clothing removed from the upper half of the body so as to expose the entire back, the patient is seated upon a stool or the side of a chair with the arms

folded in front, so as to flatten the scapulæ and expose the skin of the back as fully as possible. The front portion of the trunk is protected by a sheet, as shown in Fig. 19.

For a general application to the back, a Solar Lamp is now adjusted in such a way as to allow the parallel rays from the parabolic reflector to fall upon the upper portion of the back and the lower portion of the neck.

The intensity of the light may be adjusted either by regulation of the current or by the distance at which the lamp is placed from the patient. The regulation of the current by the rheostat is of course the most economical method.

In general the application should be sufficiently intense to produce a very decided sensation of heat. After a few moments, reddening of the skin will be observed, with perhaps the beginning of perspiration. This is an indication that the full effect of the application has been secured. The lamp should then be lowered so as to allow the rays to fall upon the lower half of the back until like effects have been produced.

When it is desired to confine the effects to the central portion of the back, as in certain forms of spinal pain, or to a single small area as in cases of tuberculosis of the vertebræ (Pott's disease), and in applications to circumscribed areas for the cure of cutaneous eruptions, the lamp should be adjusted by focusing in such a way as to concentrate the rays upon an area of the required diameter.

Local as well as general applications of the arc light, when of sufficient intensity to produce general perspiration, must be followed by a general tonic application.

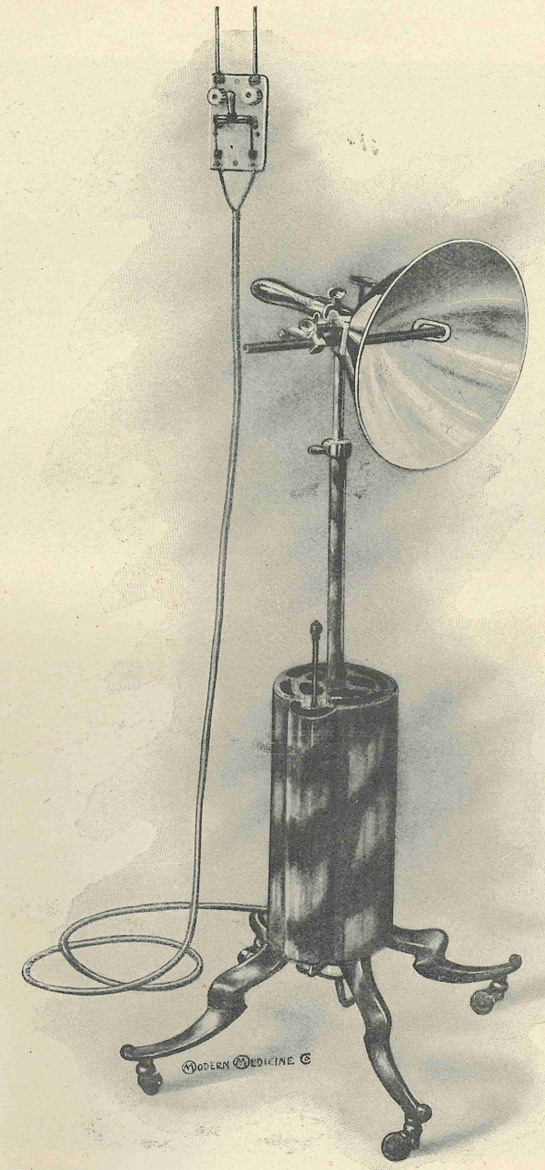

Fig. 18. The Solar Therapeutic Arc Lamp—Latest Model.
See page 88.

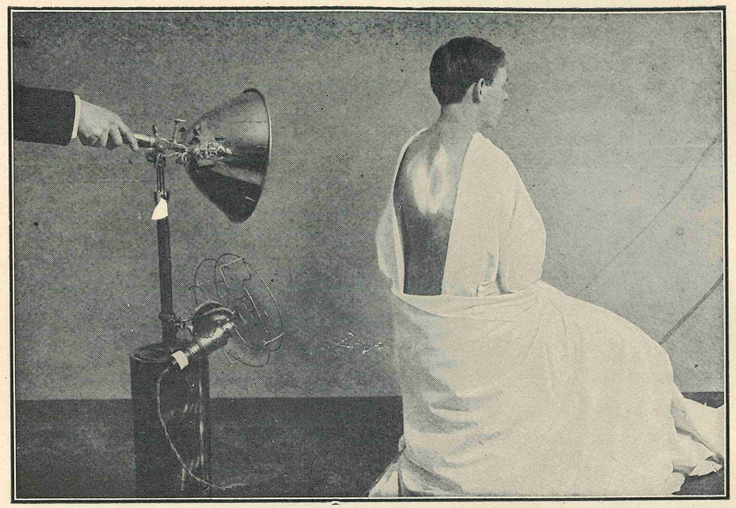

Fig. 19. Arc Light to the spine. See page 92.

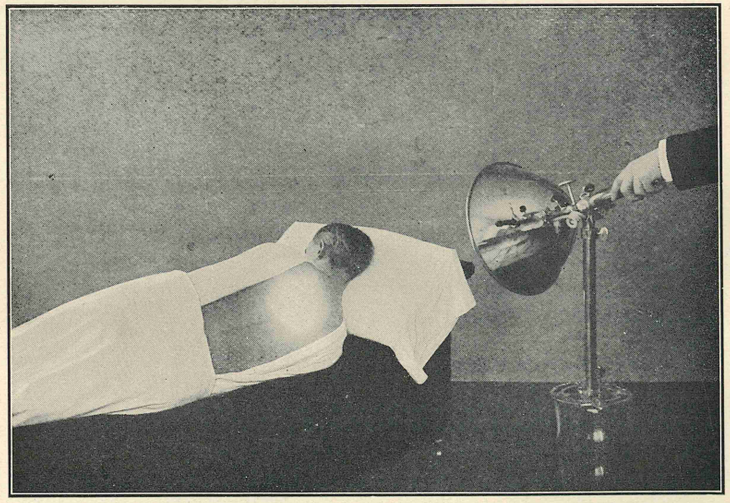

Fig. 20. Arc Light to the spine in reclining position (for feeble patients). See page 93.

(Cool water, alcohol and water, or witch-hazel and water should be used for the purpose.)

The surface treated should be sponged off at the close of the application with tepid water, or rubbed with the hands dipped in alcohol and water.

In cases of patients too feeble to sit erect, the application may be very conveniently made to the patient in bed or lying upon a couch as shown in Fig. 20. It is only necessary that the clothing should be removed and a sheet or other covering adjusted in such a manner as to protect the entire surface with the exception of the back.

INDICATIONS

Applications of the arc light to the spine are indicated in all cases of spinal pain whether due to disease of the vertebræ, neuritis or other diseases of the spinal nerves, or to disease of the liver, stomach, or other viscera—so-called referred pains. Applications of the arc light to the spine or back are particularly useful in cases of spinal hyperesthesia, referred tenderness due to gastric disease, gall-bladder disease and other reflex causes. The thermic rays of the arc light are among the most powerful means of pain inhibition yet discovered.

Solar erythema of the spine produced by the arc light is the most effective of all known means of producing derivative effects in relation to the spinal cord, and hence may be relied upon as a most effective means of relieving spinal congestion from different causes. The thoroughgoing application of the arc light to the back produces essentially the same effects as those produced by the fomentation, the thermophore and the electrophore, but very much more lasting.

APPLICATIONS OF THE ARC LIGHT TO THE CHEST

The application may be made to the front of the chest or to one side, as shown in Fig. 21.

The particular precautions necessary are to protect the eyes and the heart and to avoid making the application so long as to produce over-heating. In cases of very feeble patients when the heart is affected, a cooling coil or ice bag, covered with flannel, should be kept over the heart during the entire application. It is sometimes also wise to keep over the patient's throat a towel wrung out of ice water; in case this is done, the towel should be frequently renewed.

INDICATIONS

The indications for light applications to the chest are as follows:—

Very short applications over the heart are useful in cases of collapse under anesthesia, opium poisoning, and in cases of heart failure due to other causes.

Applications to the chest are valuable as a means of relieving pain in the chest, in intercostal neuralgia and pleurodynia. In pneumonia, pleurisy and acute bronchitis these applications are invaluable.

In the acute stage of bronchitis the application should be made for short periods only, not more than two or three minutes, and should be followed by the cold compress or the ice pack for twenty minutes, when the light application may be renewed. In pulmonary congestion from any cause these short, intense light applications to the chest are invaluable for producing therapeutic effects.

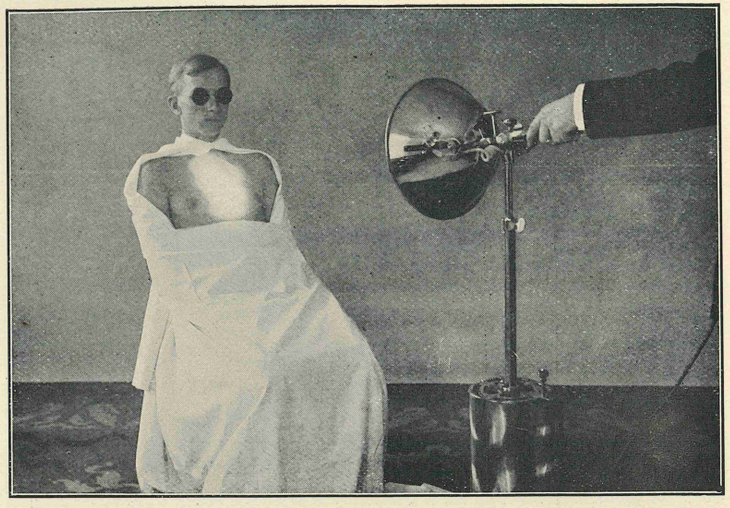

Fig. 21. Arc Light to the chest. See page 94.

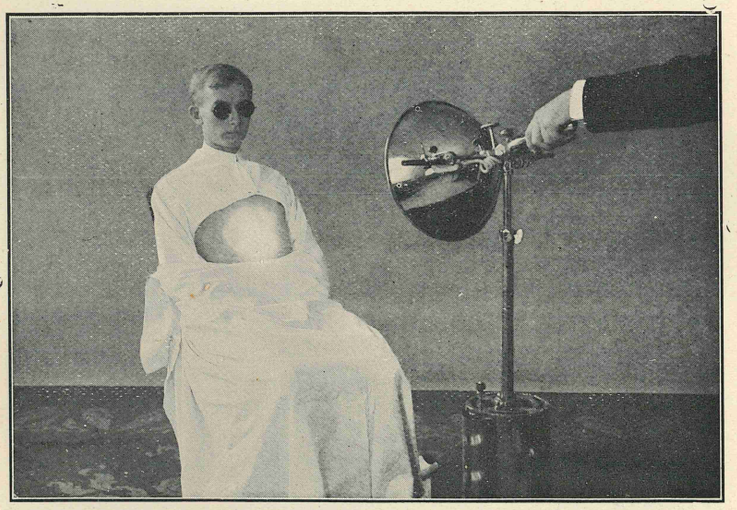

Fig. 22. Epigastric application of the Arc Light. See page 95.

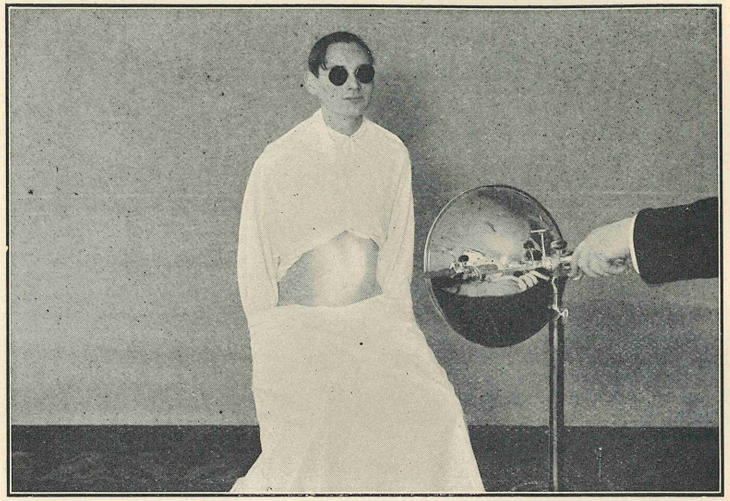

Fig. 23. Arc Light to the abdominal region. See page 96.

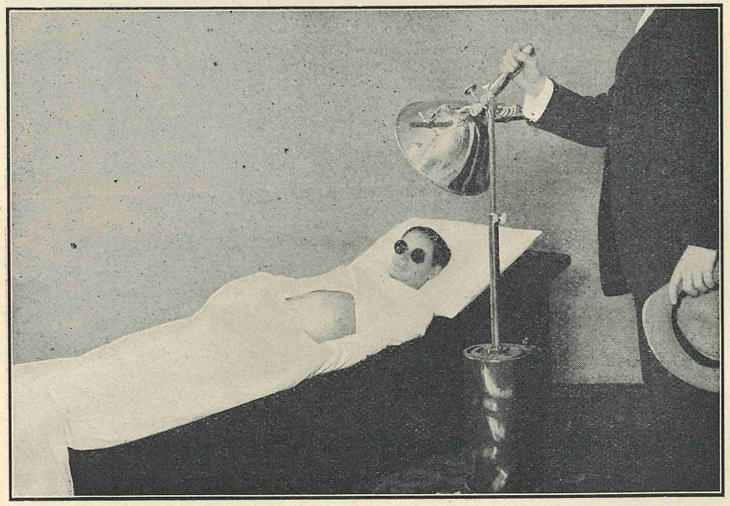

Fig. 24. Some applications in the reclining position. See page 96.

In cases of chronic bronchitis the application should be made in such a way as to produce decided solar erythema. For this purpose, of course, an arc light is required. Applications of the photophore are also valuable, especially when made to the back. They may be renewed several times a day to advantage.

The application of the photophore to the back, accompanied by a cold compress to the chest, is an excellent means of relieving passive pulmonary congestion.

EPIGASTRIC APPLICATION OF THE ARC LIGHT

The arc light affords a most efficient means of relieving gastric and hepatic pain and congestion, whether acute or chronic. The accompanying Fig. 22 shows with sufficient clearness the mode of application. The duration of the application may be made five to fifteen minutes, as there is very little danger of over-heating. The patient enjoys the bath greatly and frequently experiences relief within a minute or two after the beginning of the application. The application should be repeated daily or even twice a day in cases of chronic gastric pain, and may be followed with advantage by the heating compress.

In cases of chronic gastric catarrh, chronic inflammation of the gall-bladder, chronic duodenitis and cholangitis, it is well to produce solar erythema of this region, thus producing a permanent hyperemia of the skin, a most excellent derivative measure. This is an excellent means of relieving the gastric pain and heaviness which many chronic dyspeptics experience an hour or two after eating.

APPLICATION OF THE ARC LIGHT TO THE ABDOMINAL REGION (See Figs. 23 and 24)

This procedure is of special service in cases of abdominal dropsy due to cirrhosis of the liver, also for the relief of pain and intestinal spasm due to chronic colitis. Also indicated in chronic appendicitis, in hyperesthesia of the lumbar ganglia of the sympathetis, in gastralgia, visceral neuralgia, gastric pain due to hyperhydrochloria and other non-inflammatory, painful affections of the abdominal region.

APPLICATIONS OF THE ARC LIGHT TO THE LOINS (See Fig. 25)

The application should be as hot as can be borne, and in severe cases should be continued long enough to produce a marked erythema.

INDICATIONS

This application of the arc light is one of the best means yet discovered for relieving the pains of lumbago. It is, of course, not a radical cure for backache due to enteroptosis, visceral congestion, hemorrhoids, pelvic disease, colitis, chronic constipation and other abdominal disorders of which backache is a reflex symptom, but it is a most satisfactory measure for obtaining symptomatic relief. It may also be employed to great advantage in sexual neurasthenia in both sexes, dysmenorrhea, amenorrhea, chronic metritis, salpingitis, ovarian neuralgia and other forms of pelvic pain; in chronic prostatitis, neuralgia of the bladder, and inflammation of the bladder in both sexes; also in locomotor ataxia, spinal

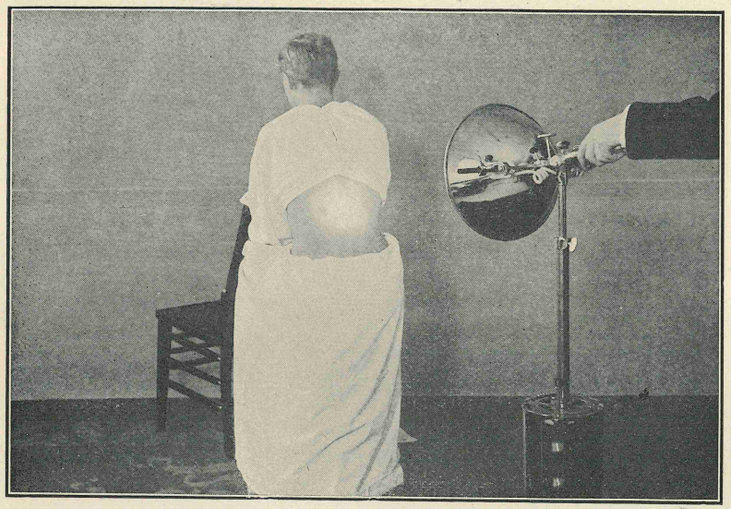

Fig. 25. Arc Light to the loins. See page 96.

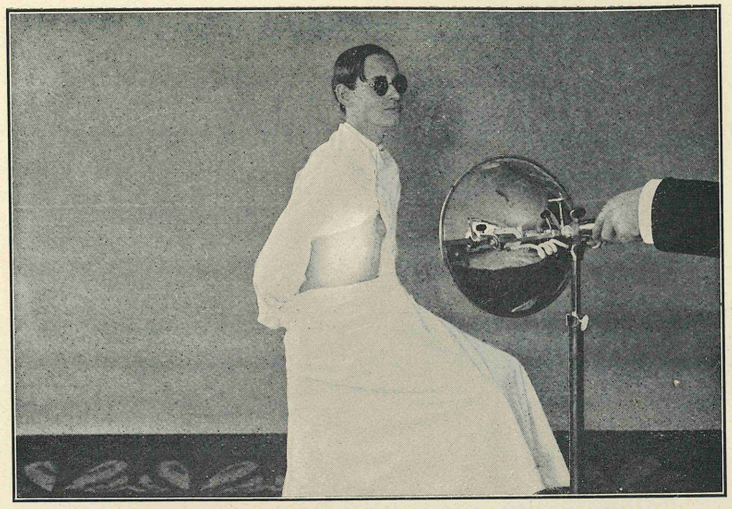

Fig. 26. Arc Light to the hepatic region. See page 97.

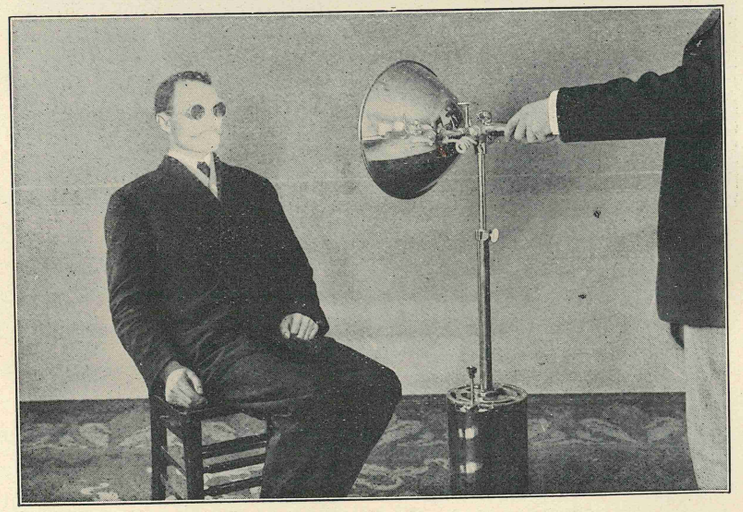

Fig. 27. Arc Light to the face. See page 97.

cirrhosis, chronic myelitis and various other functional and organic disorders of the spine.

APPLICATION OF THE ARC LIGHT TO THE HEPATIC REGION

There is probably no way in which the liver can be more profoundly influenced therapeutically than by a proper application of the arc light. The application should be made with the patient seated partly facing the lamp, but turned slightly to the left, as shown in the cut (Fig. 26), so as to permit the light to fall upon the entire area of the skin which is reflexly connected with the liver, including the left lobe. The temperature should be as high as can possibly be borne, and in very chronic, obstinate cases, it is well to continue the application long enough to produce a decided erythema.

INDICATIONS

This measure is capable of rendering great service in many cases of chronic inflammation of the gall-bladder and the biliary passages. It relieves pain and tenderness by lessening congestion and nerve sensibility. By dilating the surface vessels it diverts blood from the liver, opening up systemic channels for relief of the portal veins. This is particularly important in cases of cirrhosis accompanied by abdominal dropsy.

APPLICATION OF THE ARC LIGHT TO THE FACE

Care must be taken to protect the eyes with smoked glasses kept closely adjusted so as to exclude the actinic rays, which might otherwise give rise to a very distressing conjunctivitis (Fig. 27).

INDICATIONS

This is an extremely valuable remedy in the various forms of acne and other skin disorders. It is also an excellent means of relieving facial neuralgia and neuritis.

APPLICATION OF THE ARC LIGHT TO THE SHOULDERS (Fig. 28)

This is a potent remedy for the relief of neuritis, which is so common in this region of the body; also in neurasthenia, rheumatism and other painful affections of the shoulder joints. It has a special value arising from the fact that it may be applied in cases in which fomentations and other moist applications can not be readily made without soiling or disturbing bandages or other dressings which may have been applied. A most excellent measure for use in cases of pain following dislocation or other traumatisms of the shoulder, and amputation of the breast for cancer.

APPLICATION OF THE ARC LIGHT TO THE HIP AND THIGH (Fig. 29)

The patient should lie upon a bed or couch with the clothing adjusted in such a way as to expose the buttocks and the outer and posterior portion of the thigh. The application should extend as high as the sacro-iliac synchondrosis. A napkin should be applied to the waist to protect the anus and the genitals.

INDICATIONS

This is a most admirable measure for use in relieving the pain of sciatica, whether acute or chronic. It is also

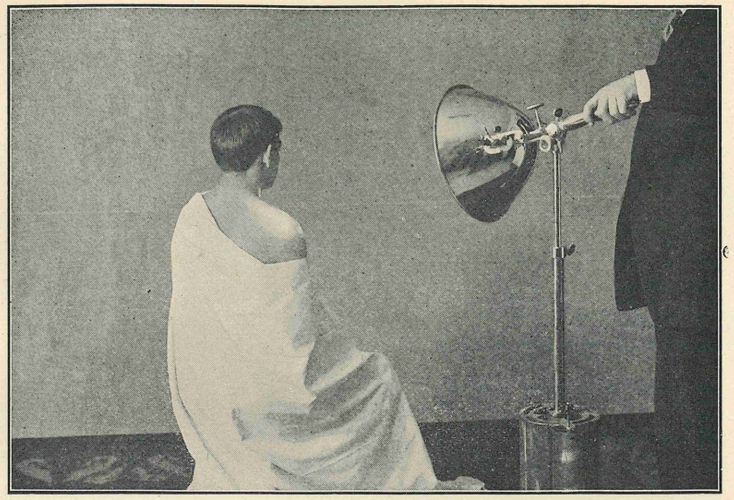

Fig. 28. Arc Light to the shoulder. See page 98.

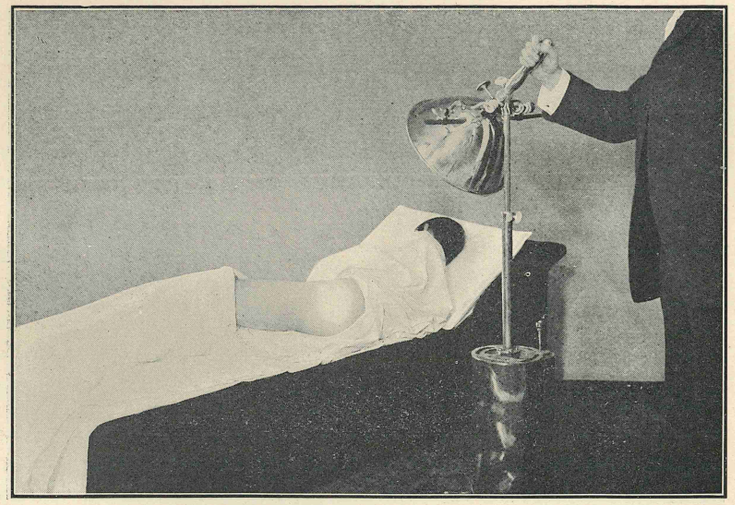

Fig. 29. Arc Light to the hip and thigh. See page 98.

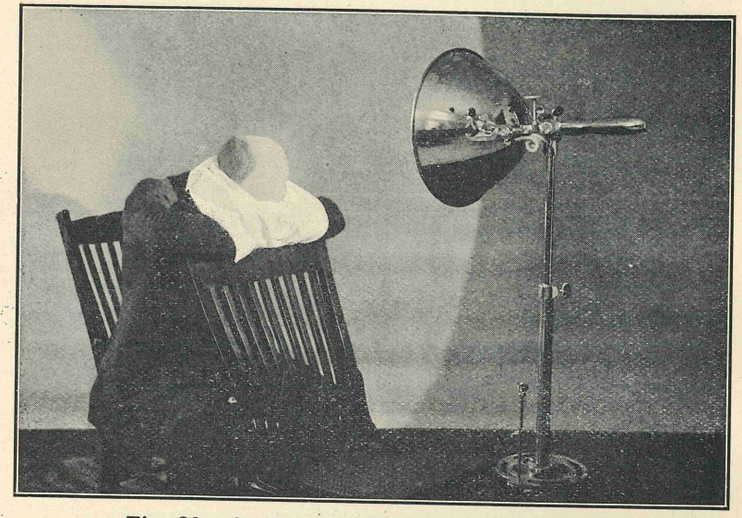

Fig. 30. Arc Light to the scalp. See page 99.

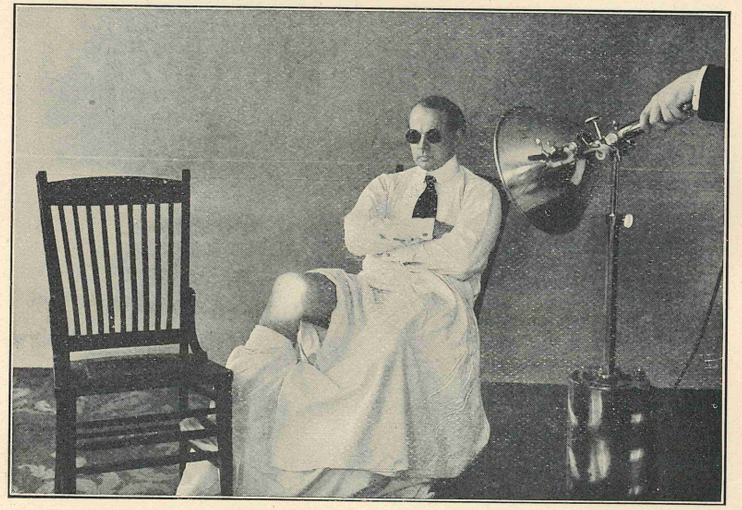

Fig. 31. Arc Light to the knee. See page 100.

useful in cases of rheumatism in the hip joint and the pain following fracture or dislocation of this joint.

APPLICATION OF THE ARC LIGHT TO THE SCALP (Fig. 30)

In applying the arc light to the scalp, care must be taken to exclude the heat rays as much as possible; hence either the blue screen or the iron electrode should be employed. The principal use of this application is to stimulate the growth of the hair. This is, however, also an excellent remedy for dandruff. In many cases a copious growth of hair has been induced on scalps which had been bald for years. Of course, it is not possible to secure a luxuriant growth of hair upon a smooth and shiny scalp in which the roots of the hair have undergone complete atrophy and destruction, but in cases in which the scalp is covered with a growth of fine soft hair, excellent results may almost invariably be obtained. The application should be sufficiently intense to produce decided hyperemia.

The use of the arc light is also indicated in cases of neuralgia of the scalp, and to relieve headache due to cerebral anemia common in arteriosclerosis, some forms of Bright's disease, and in neurasthenics with low blood-pressure. The arc light affords an excellent means of drying the hair after a shampoo, and promoting the growth of the hair. In studying the methods of Finsen, at Copenhagen, some years ago, the writer observed that the nurses employed in treating the patients presented a luxuriant growth of hair upon those portions of the hands and arms which were more or less exposed to the light of the powerful arc lamps.

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SAN FRANCISCO, CALIF.

APPLICATION OF THE ARC LIGHT TO THE KNEES AND OTHER JOINTS

The accompanying cut (Fig. 31) shows the mode of applying the arc light to one or both knees, the feet and ankles, the elbows and hands.

INDICATIONS

Applications of this sort are extremely valuable in rheumatism, whether the result of repeated attacks of acute infectious rheumatism or from intense chronic intestinal autointoxication or so-called rheumatic gout. It is also an invaluable remedy, probably the best of all local applications that can be made, in cases of joint tuberculosis. It produces more intense and more prolonged hyperemia than Bier's method. A much higher temperature may be employed than by the hot-air method. The highly energetic ultra-red rays penetrate the tissues to a depth of more than an inch, whereas the effect of a hot-air application is confined to the surface of the skin. This is the special advantage of employing the active and energetic thermic rays associated with light instead of heat in the ordinary form in which it is applied by hot air or hot water.

The pain and tenderness of joints following sprains yield to the arc-light as to no other external application. The penetrating short-wave, thermic rays reach the painful, deep-lying structures which cannot be so well reached in any other way. The applications should be made daily and in many cases two daily applications are better than one.

SOLAR ERYTHEMA, LIGHTBURN, OR PHOTO DERMATITIS

The effect of the actinic rays in producing a pronounced acute dermatitis, identical with that known as solar erythema when caused by the sun, has long been fully recognized as the result of the action of the actinic rays upon the skin. The erythema, although called a sunburn or a light burn, is really not a burn at all, because it does not appear at the time of exposure, but several hours afterward. The more intense the application, and the longer the duration of the seance, the sooner the appearance of the erythema.

A decided reddening of the skin generally occurs when the full light is used, but this is due to the dilation of the cutaneous vessels which results from the influence of the thermic rays in heating the skin. This redness usually disappears in a few minutes.

Photo erythema is of short duration. When quite severe, and when covering a large surface, considerable inconvenience may be experienced for a few hours or even a few days; but there is never sloughing, ulceration or definite injury of the skin, as so often occurs with the X-ray, so the patient may be assured of the harmlessness of this symptom when it accidentally occurs.

THERAPEUTIC USE OF PHOTO ERYTHEMA OR LIGHTBURN

The writer believes he was the first to make use of this effect of the actinic ray as a derivative and resolvent measure. For more than a dozen years the production of erythema has been a distinct and frequent aim in the treatment of selected cases, and especially in the treatment of cases of visceral disease, or of deep-seated pain, as in sciatica, and in joint affections accompanied with

considerable exudation, in bad cases of acne and obstinate psoriasis. The results in these cases are most excellent, often brilliant, and highly gratifying to both patient and physician.

The writer has become fully persuaded that when employed for general therapeutic purposes, especially in internal cases, the full effects of the arc light are not obtained without the production of erythema.

As a means of producing pronounced and enduring hyperemia of the skin, this measure can not be excelled; indeed, it appears to have no equal except the rays of the midsummer sun.

INDICATIONS

The photo erythema may be induced for derivative effects with excellent results in a variety of visceral affections, especially in the chronic passive congestions of gall-bladder disease, gastric catarrh, chronic enteritis, colitis, chronic appendicitis, and cirrhosis of the liver. In the last-named disease in particular, it is of singular service. In cirrhosis the portal obstruction leads to stasis in the splanchnic area, with impairment of all the intestinal functions. Dropsy occurs and marked increase of intestinal autointoxication. By producing a marked erythema of the whole abdomnial surface, from the lower part of the sternum to the pubes, the systemic outlets of the portal circulation are widely opened, and thus the stasis is relieved to a very considerable degree.

Backache, lumbago, sideache, and many obscure and illy defined pains yield to the potent influence of the powerful inhibition of the thermic rays, combined with the filling of the cutaneous vessels by the lasting hyperemia induced by the actinic rays.

The actinic ray is of greatest service in baldness, in acne of the face and shoulders, and in psoriasis; but in all of these conditions heat rays of moderate intensity do no harm.

THE RED AND BLUE SCREENS, AND WHEN TO USE THE THERMIC RAYS, WHEN THE ACTINIC RAYS, AND WHEN THE FULL ARC LIGHT BEAM

As a rule, for general purposes, the full beam is best. The combined influence of the penetrating thermic rays and the more irritating but less penetrating actinic rays secures the best results when the specific effects of either class of rays are not indicated.

Pure thermic rays, obtained by means of the red glass screen, are indicated whenever the soothing, pain-antidoting influence of intense heat is needed, apart from the irritating influence of the chemical rays, as in chronic eczema with thickening of the skin, many neuralgias, especially those accompanied by marked cutaneous hyperesthesia. The pure thermic rays are indicated when it is desired to stimulate metabolic activity in the stomach, liver, thyroid or kidneys, or to produce leucocytosis in a pleuritic or hepatized lung.

The actinic rays are seldom needed to the exclusion of the thermic. It is only in cases in which harm may be done by excessive heat that the blue screen must be used. It should be remembered that the actinic rays are not rendered in any respect more effective by the exclusion of the heat rays, unless a larger volume of light is used.

THE INCANDESCENT ELECTRIC LIGHT BATH

This therapeutic measure, invented by the author some eighteen years ago, is now coming into general

use in both Europe and America. Electric-light baths of a form more or less closely approximating the author's original design are found in the leading hospitals of Europe and are rapidly coming into use in the hospitals of this country, and may also be found installed in the offices of many private physicians. In time this most convenient form of general thermic application will doubtless come to be considered a necessary part of a complete bathroom outfit in private homes as well as in hospitals and sanitariums.

In a paper read by the writer before the American Electro-Therapeutic Association at its fourth annual meeting, New York, September 25, 1894, an account was given of the physiologic effects of the electric-light bath, from which the following is quoted:—

THE PHYSIOLOGIC EFFECTS OF THE ELECTRIC LIGHT BATH

"My earliest experiments in the use of the electric-light bath showed me that it was capable of producing very characteristic effects. This led me to undertake a series of physiologic experiments for the purpose of placing its therapeutic use upon a rational basis, and for the purpose of comparing the effects of the electric light, Turkish, and Russian baths. The objects of the experiments were to determine the effects of the electric-light bath as compared with those of the Turkish and the Russian baths upon—

"1. CO_2 elimination.

"2. Urinary secretion.

"3. Perspiration.

"4. Surface and internal temperature.

"5. The number of blood corpuscles and the amount of hemoglobin.

"The results of these experiments and the methods employed may be summarized as follows:—

"1. *CO_2 Elimination.*— Three healthy young men were subjected to the influence of the incandescent electric light or radiant heat bath for five, ten, twenty, and thirty minutes, respectively, the time being the same for each, and all other conditions being made as nearly alike as possible. The same young men were likewise subjected to the influence of the Turkish and the Russian baths for the same lengths of time, but on different days, care being taken to maintain a uniform dietary during the entire series of experiments, at the same hours of the day. The influence of the bath upon CO_2 elimination was determined by carefully measuring with a delicate air meter which I had constructed for the purpose, all the air expired during the ten minutes before the experiment, collecting an average sample of the air for analysis. During the bath the air was collected for the same length of time. In a case in which the bath lasted only five minutes, the figures were doubled so as to make them comparable with the rest. In case the bath lasted twenty minutes or more, the air was measured and collected during the last ten minutes; the results obtained were corrected for barometric pressure and vapor tension so that the figures given in the table for the different experiments are, in every respect, properly comparable. The results were as follows:

"The average per cent of CO_2 obtained before the experiment was 3.60.

"For the electric-light bath the averages per cent obtained were as follows:

5 minutes.....4.10 20 minutes.....4.20
10 minutes.....4.10 30 minutes.....5.10 and 5.13

"In a repetition of the thirty-minute bath, the higher percentage of 5.13 was obtained.

"For the Turkish bath the averages per cent obtained were:—

5 minutes.....4.03 10 minutes.....4.07
30 minutes.....4.01

"For the Russian bath the per cent was 3.96 for a bath of thirty minutes.

"The highest amount of CO_2 elimination was 4.29 litres, which was in the incandescent electric light bath for thirty minutes.

"The temperature of the air in the baths was as follows:—

"Electric light bath, 28 to 36° C. (85 to 97° F.), or constantly below the temperature of the body; Russian bath, 38° C. (100° F.); Turkish bath, 55° C. (131-155° F.).

"2. *Urinary Secretion.*—The following table shows the average figures obtained from the three young men who were the subjects of experiment. The facts determined in relation to the urine were: the amount, the specific gravity, the acidity, the amount of urea, the amount of uric acid, the total chlorides expressed in terms of HCl, the phosphoric acid, and the total solids. The figures given were determined by accurate quantitative analysis of the whole amount secreted in twenty-four hours. The figures obtained in relation to the most important of these quantities were as follows:—

Electric light bath: urea.....26.32 gms.
Total chlorides..... 5.25 "
Total solids.....49.30 "
Turkish bath: urea.....27.39 "
Total chlorides..... 6.91 "
Total solids.....52.70 "
Russian bath: urea.....29.56 "
Total chlorides..... 7.60 "
Total solids.....55.14 "

"The figures obtained for the urine were the exact reverse of those obtained for the CO_2 elimination.

"The diminished amount of urea, total chlorides, and total solids present in the urine during the twenty-four hours in which the subject was subjected to the electric light bath, was evidently the result of increased elimination by the skin, showing that the electric light bath is much more powerful than either the Turkish or the Russian bath as a means of stimulating vicarious eliminative work upon the part of the skin.

"The amount of perspiration induced by the incandescent electric light bath was fully double that induced by the Turkish bath in the same length of time.

"The amount of perspiration induced by the Russian bath was less than that induced by the electric light and the Turkish bath.

"3. *Perspiration.*—Two points were determined in reference to perspiration:—

(1) The time required to induce perspiration.
(2) The temperature at which perspiration began.

"The averages were as follows:—

"*Incandescent Electric Light Bath*: time required to induce perspiration, three minutes, thirty-two seconds.

The average temperature at which perspiration appeared was 27.2 degrees C. (81 degrees F.).

"*Turkish Bath:* the time required to induce perspiration, five minutes, thirty-five seconds. Temperature of the bath, 53.6 degrees C. (128.5 degrees F.).

"*Russian Bath:* the time required for perspiration, six minutes, forty-five seconds. Temperature, 101.8 degrees F.

"The above figures show very clearly the superior value of the electric light bath as a means of stimulating cutaneous activity.

"4. *Surface and Internal Temperature.*—The influence of the bath upon surface and internal temperature is a matter of importance, since Bouchard has shown that the heat-regulating apparatus of the body is called into operation by a rise in the temperature of the blood equal to .40° C. (.72° F.).

"In experiments made in December, 1891, for the purpose of determining the effect of the bath upon surface and internal temperature, I obtained the following results in a comparative study of the effects of the electric bath and the Turkish bath upon surface and internal temperature:—

"*Electric Light Bath:* temperature of bath, 34.5° C. (94° F.); internal temperature of subject before the bath, 36.6° C. (98° F.); surface temperature, 35° C. (95.44° F.). Patient began to perspire after one minute. At the end of five and a half minutes he was removed from the bath. The temperature was taken at once and the internal temperature was found to be 37.5° C. (99.6° F.); the surface temperature, 37.9° C. (100.2° F.). Ten minutes after

the bath the mouth temperature was 37° C. (98.5° F.); the axillary temperature was 36.6 C. (98° F.).

"*Turkish Bath:* temperature of bath, 70.5° C. (159° F.). Temperature of the subject before the bath, 36.4° C. (97.4° F.); axillary temperature, 96° F. Perspiration began in five and a half minutes. Immediately after the bath, the mouth temperature was found to be 37° C. (98.7° F.); axillary temperature, 37.2° C. (99° F.). Ten minutes later the mouth temperature was 37° C. (98.8° F.); axillary temperature, 36.6° C. (98° F.).

"From these statements it appears that the incandescent electric light bath is far more effective than the Turkish bath in raising both surface and internal temperature, which clearly indicates the penetrative power of the intense heat rays of the electric light.

"5. *The Blood.*—The effects of the incandescent electric light bath upon the blood were determined by a careful count of the corpuscles by Gower's instruments and a determination of the hemoglobin by the hematoscope of Henocque. The figures obtained showed no very marked increase in either blood corpuscles or hemoglobin, although in one case the number of corpuscles was increased nearly 200,000 per cubic millimeter.

"The physiological effects of the electric light bath are chiefly those of heat, and do not differ very essentially from the effects obtained from other sources of heat, except that the electric light bath is a much more efficient and convenient method of administering heat than any other which has been devised, with the exception of water, which doubtless has a wider range of use."*

* "The Incandescent Electric Light or Radiant Heat Bath," New York, 1894.

These observations were later fully confirmed by Winternitz, of Vienna, who referred to the bath as follows:—

"The electric-light bath presents an advantage over every other means of applying heat in the readiness with which the dosage may be regulated as regards time and intensity. The instant the switch controlling the circuit is closed the whole force of the bath or that portion of it in use is brought to bear at once upon the body. The instant the circuit is opened the heat is wholly and absolutely withdrawn. By means of properly adjusted switches, whereby the number of lamps in use may be controlled, the amount of heat applied may be exactly regulated.

"Another advantage of the electric-light bath is that it does not interfere with heat elimination. It in fact encourages heat elimination by encouraging free perspiration. Many other forms of hot applications, particularly hot-water baths and sweating packs, cause retention of bodily heat. In the electric-light bath, the heat elimination and the excretion of effete matters which accompany vigorous perspiration proceed with increased activity at the same time the rays of radiant heat are penetrating the tissues, elevating the temperature of the blood, and quickening all the vital processes.

"The importance of this property of the electric-light bath is clearly shown by the interesting experiments of Conrad Klar. This investigator showed by calorimetric experiment that with the body exposed in an atmosphere somewhat below the body temperature, heat elimination was during the first five minutes ten times the normal amount; while during the second five minutes

the amount of heat eliminated was half as great. The diminished loss during the second five minutes was doubtless due to contraction of the blood-vessels of the skin. In the electric-light bath the cutaneous vessels are thoroughly relaxed, and this condition is maintained by the action of the rays of light falling upon the skin while the air about the patient is but little above the ordinary atmospheric temperature, a condition which in the highest degree favors heat elimination.

"The electric-light bath is a new invention by Kellogg, Battle Creek, Mich., U. S. A. It is undoubtedly true that radiant heat penetrates the tissues much better than conducted heat, and it is very probable also that the inner life of the cell is influenced by the radiant heat, either qualitatively or quantitatively, and to a higher degree. All the effects of the vapor bath can be produced by the electric-light bath. The loss of carbonic acid gas is considerably greater in the electric-light bath than in the vapor bath, and what is especially remarkable, perspiration occurs very quickly and at a very low temperatrue, and is very profuse. [Indications of perspiration are sometimes noticed at 28° C. (95° F.). The author has observed perspiration at 85° F., and Professor Winternitz stated to him personally (1899) that he had seen moisture appear upon the skin in a single instance at 65° F. The patient was a somewhat excitable neurasthenic, and very susceptible to the stimulus of radiant energy.]

"Ordinarily a much higher temperature is necessary before symptoms of sweating occur in the vapor bath. The time required to produce sweating in the electric-light bath is commonly 3½ minutes, whereas about five

minutes are required in the vapor bath. Finally the quantity of perspiration is considerably greater in the electric-light bath. That the radiant heat is the main cause of this, and not the heated air, was evident from the observations made by us that the external part of the leg upon which the rays of light directly fell perspired very much more quickly and profusely than the internal part of the leg, which received only reflected rays. After 10 to 30 minutes the body temperature increased to 40° C. (104° F.), the pulse to 160, respiration to 42,—symptoms of the condition resembling fever. We have used the electric-light bath in ways analogous to the use of the vapor bath in a number of cases of sclerosis, rheumatism, and gout, and have been much gratified with the results. We have as yet made no further experiments. Kellogg reports very good results in sclerosis, arthritis, and many disorders of nutrition. Lehmann has been very successful in psoriasis. Since we have in the electric-light bath a thermal method by which the degree of heat applied can be exactly measured and regulated, and knowing the powerful influence of light upon the life of the cell and of the whole organism, we believe that this method will hold a prominent place among the forms of thermal applications, and that we shall be enabled by its use to influence a series of maladies more quickly, more effectively, and more satisfactorily than heretofore."

THERAPEUTIC APPLICATIONS

During the eighteen years which have elapsed since the writer constructed the first electric-light bath, he has found the field of application for this convenient thermal measure continually widening. This device has, in-

deed, proved to be of far greater value in the treatment of a large variety of maladies than any other means of applying heat except water, and admits of much more general employment than the ordinary Turkish, Russian, vapor, or hot-air baths. One reason of this is the convenience and rapidity with which the degree of heat may be graduated by turning on or off one or more groups of lamps, the amount of heat being thus rendered absolutely and instantly controllable, since the source of heat relied upon is the incandescent filaments of the lamps rather than a heated atmosphere. The instant the lamp is turned off, the heat which had previously been emitted is withdrawn from operation. If additional heat is required, the desired number of lamps may be turned on, and become instantly operative. Still more perfect regulation may be effected by means of a simple rheostat.

Another reason for the more universal utility of the incandescent-light bath is the fact that when properly applied, its effects are highly tonic in character. A short application of the bath at full intensity for a time just sufficient to induce strong heating of the skin without provoking perspiration is a most effective means of cutaneous stimulation. The tonic effects of such an application may be still further intensified by instantly following the bath with a cold spray or other cold application, thus producing a revulsive effect of the most agreeable and effective character. The intense heating of the skin prepares the way for the cold application, without at the same time so overheating and relaxing the blood-vessels as to render recovery of the tone of the cutaneous tissues so tardy as to involve the risk of exhausting the patient too greatly or exposing him to the liability

of taking cold. In the experiments referred to, the amount of perspiration produced in the electric-light bath was found to be double that produced in the Turkish bath. The body temperature is also raised much more rapidly in the electric-light bath than in any other form of hot bath, because the rays of radiant energy pass through the skin and reach the interior of the body at once, whereas in the ordinary hot bath the heat penetrates the tissues very slowly, and only reaches a small distance beneath the surface.

The electric-light bath is especially valuable in cardiac disease and in diabetes, in which prolonged sweating measures can not usually be employed without more or less risk. The penetrating nature of the heat of the electric-light bath stimulates oxidation of the residual tissues, and thus hastens the disappearance of redundant fat in *obesity*. In *dropsy*, associated with either cardiac or Bright's disease, in the *toxemia of chronic dyspepsia*, and in all conditions for which general and local applications of heat are applicable, the electric-light bath stands pre-eminent.

Chronic malarial cachexia, syphilis, diabetes, obesity, neuritis, neuralgia, acute nephritis, migraine, neurasthenia, tetany, habit chorea, and *hysteria* yield good results to the thermic impressions of the electric ray.

In *rheumatic* and *anemic* patients, and in all cases when the heat-making capacity is small, the electric-light bath serves an exceedingly useful purpose in preparing the skin for cold applications by storing up in it a supply of heat. And it serves a useful purpose in this way, not only in preparing the patient for tonic applications of water, but as a means of producing most excellent revulsive effects. For pure revulsive effects, only the circulatory reaction is desired, it being, in fact, necessary to suppress thermic reaction altogether. Hence the duration of cold applications which follow hot applications should be such as exactly to neutralize the heat which has been absorbed by the skin in the previous hot application. The electric-light bath is superior to all others in the treatment of *chronic rheumatism* and all maladies dependent upon chronic toxemia, owing to its ability to elevate body temperature while at the same time producing vigorous cutaneous activity. The elevated temperature stimulates the oxidation of protein wastes, and augments vital combustion, while the increased skin activity carries off the waste products prepared for elimination.

Recent physiological experiments have shown that the elevated temperature in febrile conditions is one of the methods by which nature combats the causes of disease, or neutralizes some of the morbid conditions resulting from disease. The physiological effects of the electric-light bath may exercise in many cases a strongly curative influence by the elevation of the body temperature, thereby enabling it to produce antitoxins, or to render effective the curative efforts instituted by the *vis medicatrix naturæ*.

As a prophylactic, this bath also possesses a high value, especially for persons who live a sedentary life, as teachers, doctors, lawyers, preachers, judges, and professional men generally, and to a still greater degree for the majority of women, as it is the best substitute for muscular activity in the open air.

The hygienic value of the sweating bath is certainly

scarcely yet appreciated by the majority of civilized men and women. This cannot be said of the Finns, however; for in Finland every house has connected with it a bath-house with conveniences for producing vigorous perspiration. Indeed, the author, while on a recent visit to Copenhagen, was told by an intelligent Finnish gentleman that it is the custom in his country for a young man anticipating matrimony to build as a foundation for his future home, first of all, a sweat-house. A vast multitude of city dwellers in civilized countries are suffering tortures from disease in various forms, and dying prematurely, because of the neglect of that important provision in the injunction of the Almighty to Adam, "By the sweat of thy brow shalt thou eat thy bread." Indeed, the neglect to sweat is one of the most prolific causes of disease in the conditions of civilized life. A modern writer has very sagaciously suggested that the chief difference between the savage and the civilized man is in the way he sweats. The savage sweats his brow in earning his bread, and taxes his brain but little; the civilized man earns his bread by the sweat of his brain, but seldom sweats his brow.

Sweating by the electric-light bath, while not a complete substitute for the sweating produced by exercise, certainly comes nearer to being so than any other sweating process; and when followed by some vigorous cold application, as the cold bath, possesses a hygienic value which cannot be overestimated.

M. Below, who has for some time employed the electric-light bath constructed after the author's plan, reported in a paper read before the medical society of Berlin in 1898, a considerable number of cases in which the

bath had been successfully used in the treatment of rheumatism, syphilis, and various other morbid conditions.

CAUTIONS AND CONTRAINDICATIONS

The electric light acts far more quickly than any other heating procedure for the reason that its rays instantly penetrate deep into the tissues two inches or more, and thus the body temperature is quickly raised. It is well to take the patient's temperature just before the bath and immediately after, and even during the bath if it is much prolonged. In a powerful bath the body temperature may rise to 103° F. or more in a few minutes (15 to 20 minutes). The general light bath should not be given to a patient who is in a febrile condition.

Intense heat is depressing, especially to the heart; hence it is necessary to protect the heart during the application by means of an ice bag or a cool compress.

The electric-light bath is too exciting for certain forms of skin diseases, especially when the eruption is moist and when intense itching or burning is present.

THE PHOTOPHORE (Figs. 10, 11, 34)

While the arc light is perhaps the most efficient and useful of all methods of applying heat to the general surface of the body, the photophore is equally pre-eminent as a means of making local applications of heat. A radical defect in the hot-water bag and other means by which heat is conveyed to the body by contact is the fact that from the moment the heated body is brought in contact with the skin its temperature steadily diminishes through the loss of heat. At the same time the tolerance of the skin for heat gradually increases as the

contact is prolonged. This requires frequent renewal of the heat to produce a decidedly pronounced effect. The photophore entirely overcomes this difficulty. The volume and temperature of the thermic rays emitted from the incandescent film remains practically the same during the entire period of the application. The supply of heat being ample, the maximum effect desirable under the conditions is always attainable.

The photophore is made in varying forms and adapted to various uses. The capacity is also regulated by varying the size or number of the incandescent lamps employed. The cuts (Figs. 10, 11, 34) show the several forms which have been designed for use in the Battle Creek Sanitarium, where this therapeutic appliance was first made and employed under the writer's direction, and where it has been in very extensive use during the last seventeen years.

INDICATIONS

The photophore is one of the most effective means of relieving pain. The value of heat as a means of inhibiting pain cannot be overestimated. There are almost no forms of pain which are not greatly mitigated by the proper application of heat, and in the majority of cases complete relief can be obtained by a suitable application of heat by means of the photophore. For a fuller discussion of the subject of heat as a means of relieving pain, the reader is referred to the author's articles on this subject in Cohen's *System of Physiologic Therapeutics** and his work entitled, *Rational Hydrotherapy*, pages 265-269.

* Volume ix, pp. 242-278. (Blakiston.)

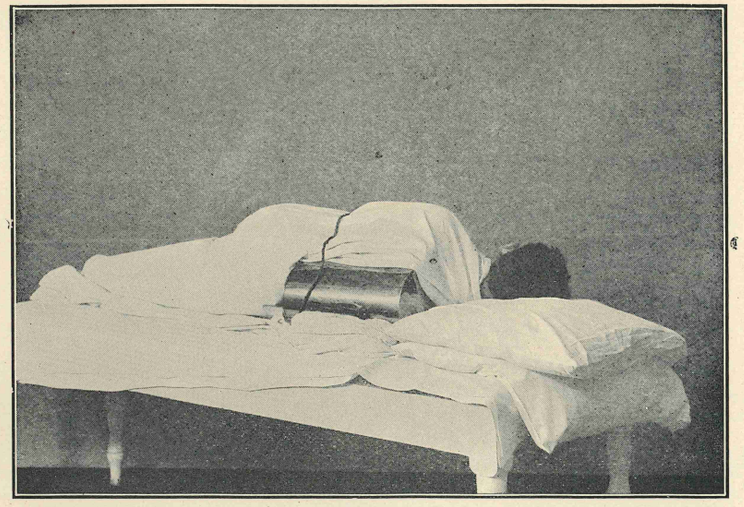


Fig. 32. Application of the Photophore to the spine. See page 119.

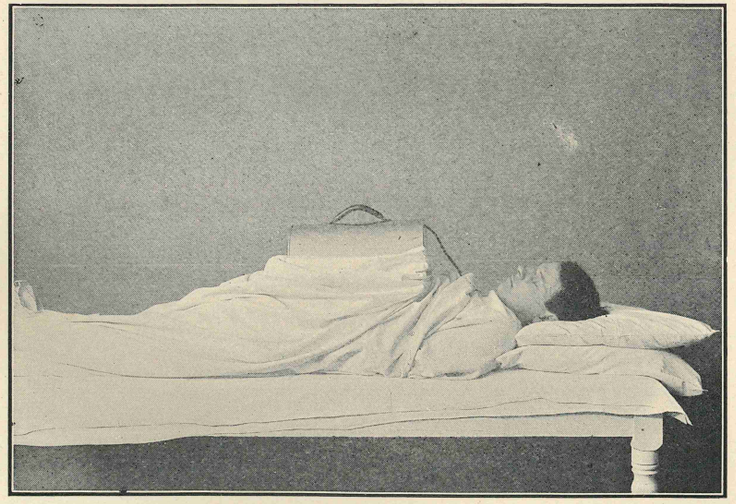


Fig. 33. Application of the Photophore to the abdomen. See page 119.

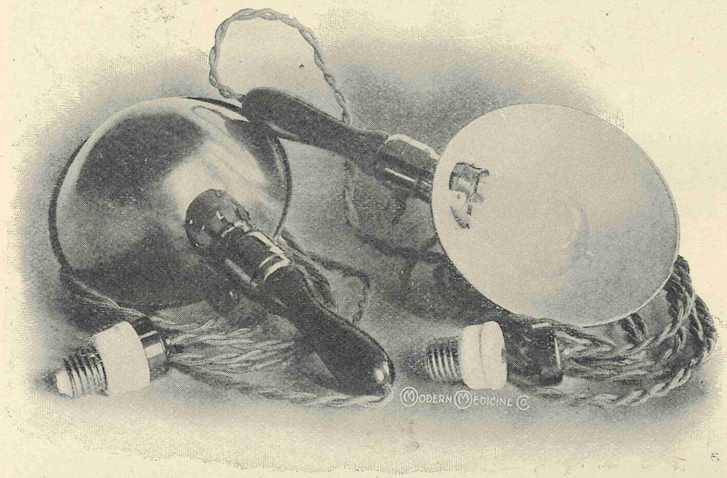


Fig. 34. The Hand Photophore. See page 121.

The accompanying cuts (Figs. 32, 33) illustrate the application of the photophore to various parts of the body.

TECHNIQUE OF APPLICATION

Great care should be taken that the metal parts of the photophore do not come in direct contact with the patient's skin. The parts most liable to contact are protected by a non-conductor; but in application of the photophore to certain parts of the body, contact with unprotected portions of the photophore may easily occur, hence special precautions are necessary.

The heat of the photophore is so intense that the skin may be easily burned if there is any loss of sensibility. Special care must therefore be taken to avoid too close contact or too high a temperature in cases in which the cutaneous sensibility is impaired. When the application involves a large surface or is long continued, general superheating of the body and even perspiration may be induced, and hence proper precautions must be taken so that the patient may not take cold on going into the open air after the treatment. This is especially important in cold weather. In hot weather it is also important to avoid this general overheating by having the patient's clothing removed during the treatment.

In many cases it is well to place a cold cloth or an ice bag over the heart to avoid a depressing effect. The surface treated should always be cooled after the application by the sponge or hand-bath with tepid water, alcohol-water or witch-hazel. In cases in which the object of the application is to reduce a chronic exudate or to re-

lieve tenderness or persistent pain, the application should be followed by the heating compress.

Powerful revulsive effects may be obtained by rubbing ice upon the skin at the conclusion of the treatment or at intervals of one or two minutes during the application.

THE INCANDESCENT LIGHT BATH IN BED

By means of three two-light photophores an excellent incandescent electric light bath may be administered in bed. The photophores and the patient should be arranged in the following manner. The patient being placed in bed, lying upon one side, a two- or three-light photophore is applied on either side of him and another photophore at his feet. The patient and the photophore are then covered by a sheet and one or two woolen blankets, the covering being tucked in snugly about the neck and shoulders. The edges of the sheet and blanket may, if necessary, be attached to the mattress with safety pins to keep them from coming in contact with the body of the patient. After the bath has progressed for a few minutes the patient may think it desirable to turn upon the opposite side, to enable the light rays to act upon every portion of the surface.

An incandescent arc light bath administered in this way is just as effective as when given with a larger and more expensive apparatus, though perhaps somewhat less convenient in application. However, there are many cases in which the patient is extremely feeble or otherwise unable to move from the bed to the bath or to sit upright in bed. In such cases the improvised bath in bed above described will be found an extremely satisfactory substitute for the usual form. This bath has also the

advantage of being available in any room of a private home or hospital lighted by electricity. It is also economical in the use of current.

THE COMBINED ARC LIGHT AND INCANDESCENT BATH

The combined effects of the arc light and incandescent light may be secured by two methods: first, by means of a cabinet in which are arranged both arc light and incandescent light; and second, by means of a window in the incandescent light cabinet through which the rays from an arc light may be introduced upon some particular area of the surface as may be desired. A small door for this purpose may be arranged in the door of the cabinet, or the door of the cabinet may be opened and the light projected into the cabinet. Applications of this sort are usually made to some portion of the abdomen or back. By this combined method the most powerful effects known to phototherapy can be obtained.

THE HAND PHOTOPHORE

This convenient instrument, shown in Fig. 34, is especially useful in cases in which it is desired to employ the highest temperature possible. In application the photophore is held in the hand with the elbow properly supported, and the rays are made to fall in rapid succession upon the different parts of the area to be treated, by simple rotation of the arm, causing the photophore to describe the small arc of a circle of which the hand and forearm are the axis. By this means a much higher temperature can be borne than when the application is continuous, and thus more powerful inhibitory effects may be

induced. This measure is especially useful in the treatment of sciatica and lumbago and other forms of chronic neuralgia, especially in the shoulders, back and other parts.

COMBINED LIGHT AND ELECTRICAL BATH

This is a combination of the sinusoidal or the high-frequency current with the ordinary electric bath cabinet. The author's sinusoidal apparatus, and the electrodes usually provided with it, are shown in Fig. 35.

Seven electrodes are provided inside the cabinet, one for each hand and each foot, also for the back, the seat, and the abdomen.

Outside, the cabinet is provided with a switchboard having fourteen switches, two for each electrode. The switchboard is connected with a sinusoidal or a high-frequency apparatus, or even a faradic or galvanic battery, as may be desired. The current must be controlled by a rheostat, and it is very desirable—and absolutely necessary in case the galvanic current is used—to have in connection with the cabinet circuit a current-measuring device, such as a milliamperemeter or a voltmeter, or both.

In use, the patient is placed in the cabinet, the light is turned on, and after one minute the sinusoidal current is turned on—at first a very gentle current, and later, strong enough to cause distinct muscular contraction in the parts to which the current is applied.

Various combinations may be made by adjusting the switches of the switchboard. The following combinations are most useful:—

Spine positive, hands and feet negative: for general

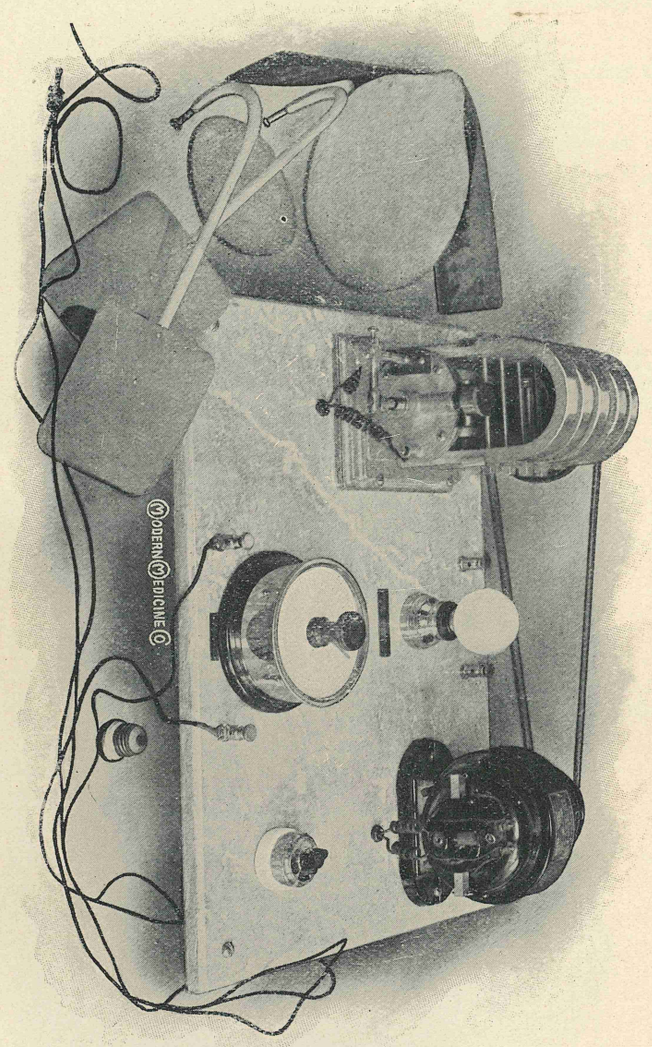
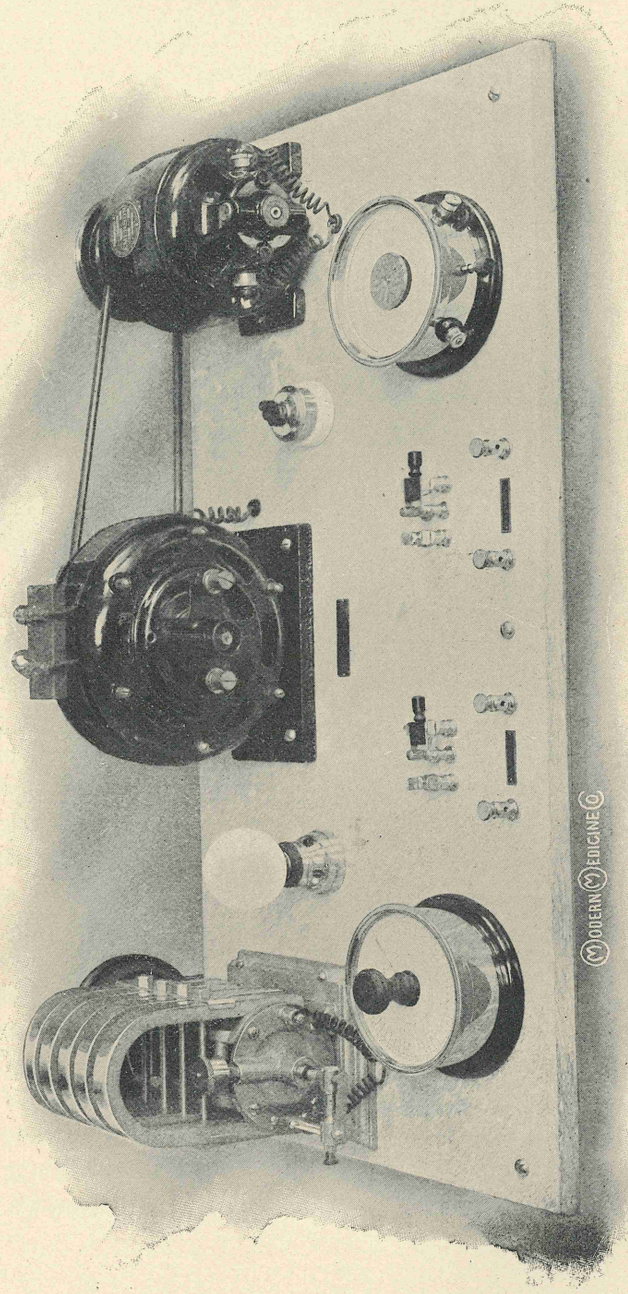


Fig. 35. The Author's Sinusoidal Apparatus, D. C. Motor, showing Special Electrodes. See page 122.



The Author's Combined Sinusoidal and Galvanic Apparatus.

effects, especially when it is desired to stimulate destructive metabolism, as in diabetes and in obesity.

Spine or seat positive, feet negative: to exercise the lower extremities.

Spine positive and abdomen negative: to exercise the abdominal and other trunk muscles and increase their tone.

Spine positive and hands negative: to exercise the muscles of the arms.

The effects of this bath are highly tonic and restorative. It affords an excellent remedy for rheumatism, and is a most excellent measure for rapidly reducing surplus flesh.

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VI.

Phototherapy Plus Hydrotherapy

PHOTOTHERAPY cannot be considered in itself a complete physiologic system for the reason that it offers no cooling procedure. Its effects are thermic and chemical, and in practice the two are always combined.

There are certain inconveniences accompanying all superheating procedures which must be compensated for if undesirable results are to be avoided. For example, it might be exceedingly disastrous to send out into the cold air of January a patient who has just emerged from an incandescent light bath, or an application of the arc light to the back or any other large area. The cutaneous circulation is relaxed by hot applications, and its tone must be restored before the patient is released from the attendant's hands. Cool or cold water and cool air afford the most ready means of accomplishing this. Evaporating lotions may likewise be used.

There are also certain depressant effects which follow and often accompany intense or prolonged applications of heat; these must be antagonized or compensated for by excitant or tonic applications of cold water or cold air.

The combination of the eliminative, resolvent, derivative and inhibitory effects of phototherapy with the tonic, excitant and restorative effects which may be secured by suitable hydriatic measures forms a most fortunate therapeutic partnership.

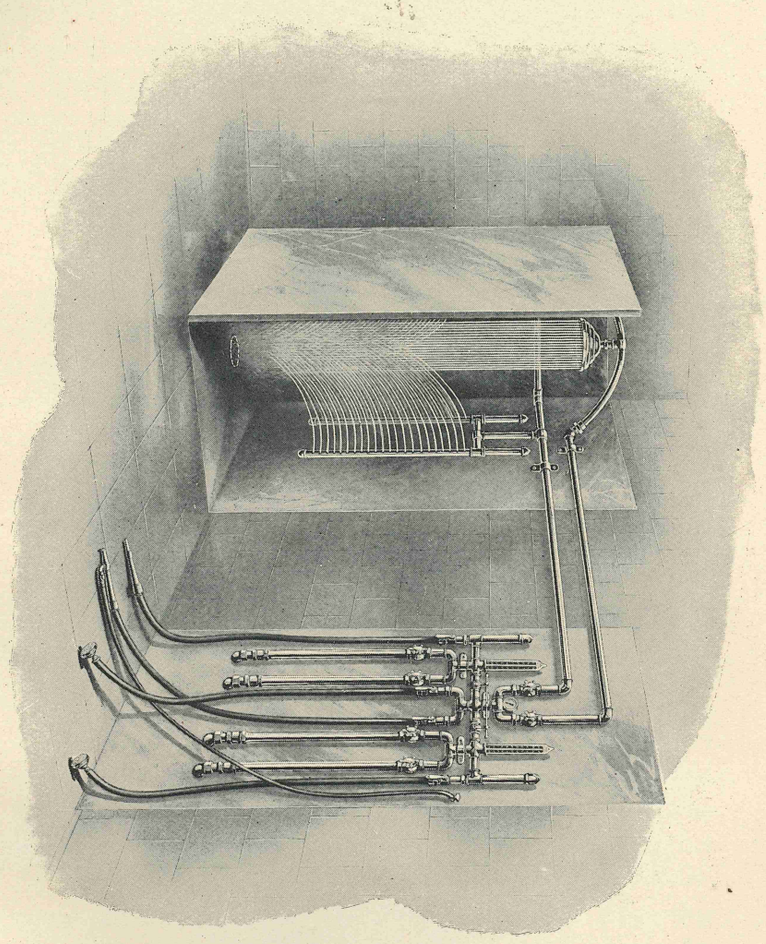

Fig. 36. The Author's Douche Apparatus. See page 126.

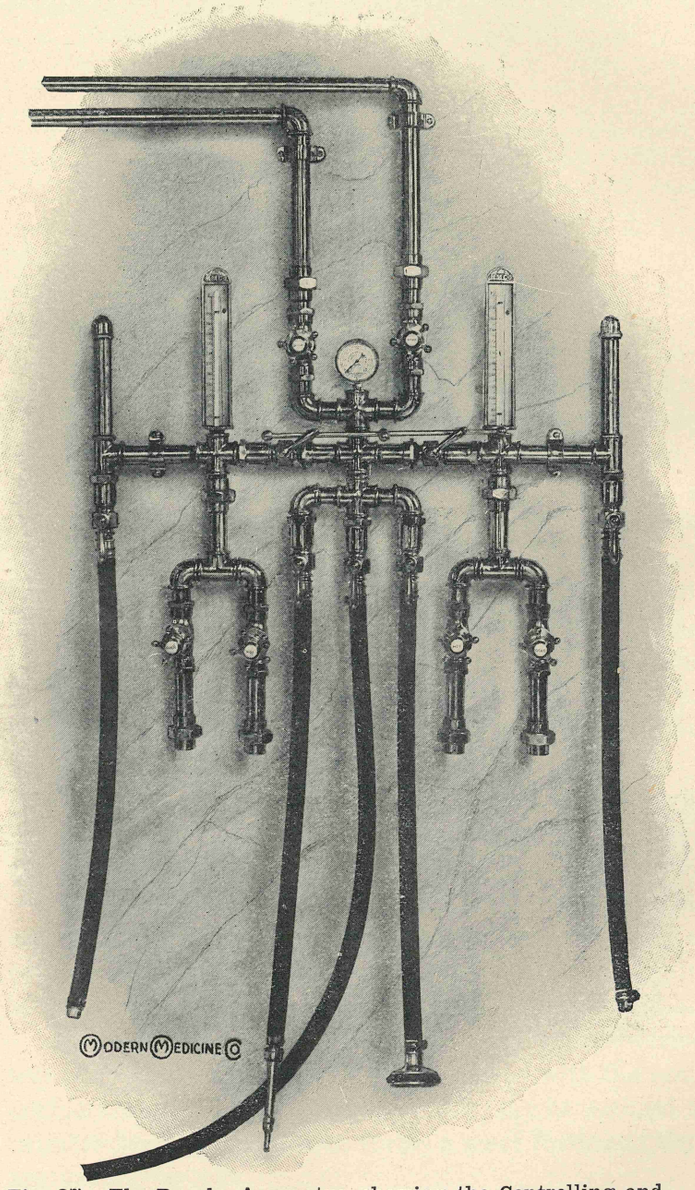

Fig. 37. The Douche Apparatus, showing the Controlling and Regulating Mechanism. See page 126.

Every physician who equips his office with the necessary appliances for the use of phototherapy should likewise equip his mind with information concerning the combined use of hydrotherapy with light applications, and should see that his office is supplied with facilities for at least the more simple hydriatic measures. These may be very few and inexpensive, or elaborate and comprehensive, as may suit the circumstances. Effective work can be done with a hand bowl and a towel, but there is always an opportunity for greater and better things. Phototherapy is a resourceful method and is daily accomplishing therapeutic wonders, but in the writer's view its greatest and most useful function is to introduce, and aid in establishing in modern medical practice, scientific hydrotherapy and the physiologic method.

The principles involved in thermic applications of light are practically identical with those of thermic applications made by means of warm or hot water, hot air or steam. The limits of this volume will not permit a complete study of this subject, and the reader is earnestly urged to secure and study some one or more of the excellent treatises on hydrotherapy which may now be had. The author would especially commend the admirable books by Winternitz, Strasser, Buxbaum, Bottey and Beni-Barde. Baruch has the honor of being the first American to present a comprehensive treatise on this most vital subject. The author also desires to mention his own work, *Rational Hydrotherapy,* as a guide to hydriatic practice, and takes the liberty to borrow from this work the following paragraphs and illustrative cuts descriptive of procedures which are of special service in connection with the application of phototherapy:—

THE COLD DOUCHE (Figs. 38, 39)

For a full discussion of the physiologic effects of the cold douche, and of its special indications and contraindications, see *Rational Hydrotherapy,* pages 426 to 522.

The accompanying cuts show the author's douche apparatus (Figs. 36, 37).

The jet douche consists of a single stream, varying in diameter from a millimeter or less (the filiform douche) to an inch or even more. The usual size is about three-eighths to half an inch. The horizontal jet is applied by means of a nozzle not unlike that of a garden hose, attached to a piece of rubber tubing two or three feet in length, so as to permit free movement.

In administering the horizontal jet, water may be employed at any temperature applicable to therapeutic purposes. The full force of the stream may be used where indicated, or the pressure may be broken, either by adjustment of the pressure-regulating valve or by breaking the force of the stream by placing the end of the finger in the stream near the mouth of the nozzle so as to scatter the column of water to the extent desired. The last-named means of lessening the pressure is always available, and must be used in all general applications in adapting the force of the stream to the different regions of the body.

The temperature of the *cold* douche is from 45° to 65°; of the *cool* douche, from 65° to 80°; of the *tepid* douche, from 80° to 92°; of the *neutral* douche, from 92° to 97°; and of the *hot* douche, from 104° to 125°.

The employment of so vigorous a therapeutic procedure as the cold douche should always be conducted under

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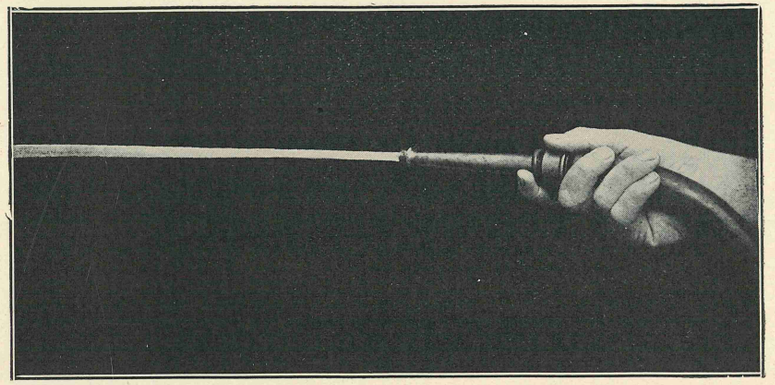


Fig. 38. The Horizontal Jet. See page 126.

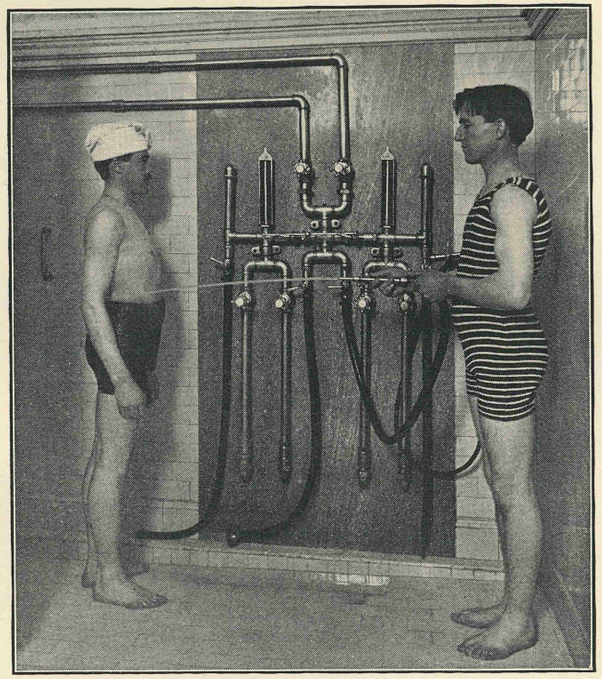


Fig. 39. Horizontal Jet to the abdomen. See page 127.

the immediate supervision of an intelligent person who has been specially trained.

The *broken jet* is used over the heart and anterior portions of the chest; to the cervical region; and to all sensitive parts, as over the stomach, liver, bowels and uterus, in inflammation of these organs; *to inflamed or sensitive points; and over painful nerves.* The full jet, at appropriate pressure, may be used upon the back, arms, legs, feet, and over the liver and spleen when not contraindicated.

The head must be very thoroughly cooled before the douche, and should be protected by a cold towel around the head or neck or both. The jet is usually first applied to the back for a few seconds, then the legs and arms, then over the anterior portions of the body and the liver, ending with a strong dash upon the feet. The whole body may be gone over several times in the manner suggested, each particular region being carefully respected as regards the appropriate degree of pressure, the patient turning around as directed by the attendant.

When the patient has previously been prepared for the cold douche by a heating process of some sort, which is generally the case, great care must be taken that he does not become chilled by exposure to the cooling effect of evaporation. To avoid this a cold procedure should follow the hot application instantly; or if a short interval must intervene, a few seconds perhaps, the patient must be protected by a warm woolen blanket. If there is the slightest cooling off by evaporation, causing chilliness, or if an interval of a minute or two has elapsed by reason of some emergency, the skin must be thoroughly warmed up again by a hot rain or needle douche before the cold

jet is applied. The condition of the patient should be such that the cold water will not be regarded with extreme aversion and dread.

THE SHALLOW BATH (Figs. 40 and 41)

In this procedure the patient is rubbed while sitting in a tub partially filled with water. The requisites are a tub with four or six inches of water of the proper temperature, a sheet, two or three towels, and a large dipper.

The patient, having been properly prepared,—the feet warm, the general circulation well established by exercise or previous warming in bed or by a warm bath, the head protected by a towel wet with water at 60°,—seats himself in the tub with the legs extended, and immediately begins vigorous rubbing of his arms, chest, and abdomen, while the attendant rubs the back and sides with both hands for 20 seconds, then dips water from the tub and dashes it upon the back for 10 seconds, then rubs 20 seconds, then the patient lies down in the bath while the attendant rubs his legs for 10 seconds. This occupies just one minute. For a two-minute bath, the above is repeated; for a bath of three minutes, the procedure is repeated a third time.

At intervals of one minute the patient should lie down in the bath, so that the whole body except the head is submerged for 5 to 10 seconds, the attendant rubbing the legs vigorously in the meantime.

When employed for tonic effects, the temperature of the water should be 75° to 65°, and the length of the bath 1 to 3 minutes. For the reduction of temperature in febrile cases, the temperature should be 85° to 70°, and the duration 6 to 15 minutes.

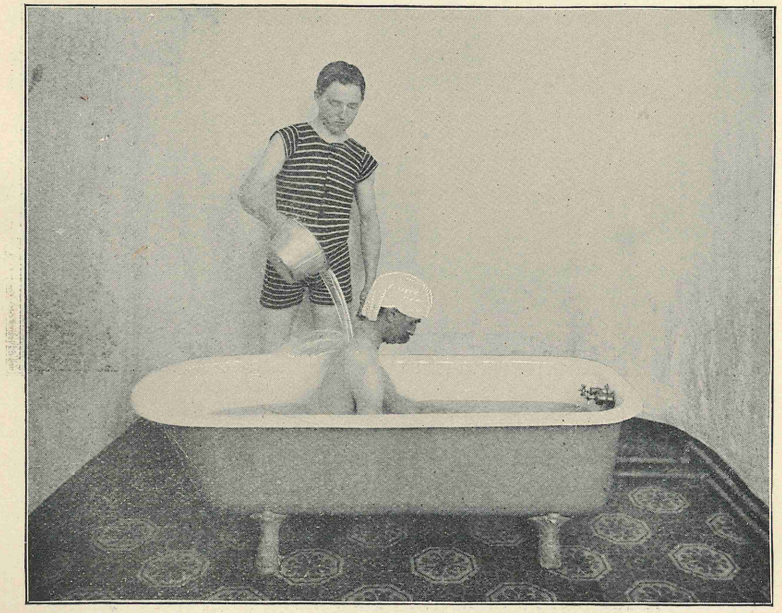


Fig. 40. The Shallow Bath. See page 128.

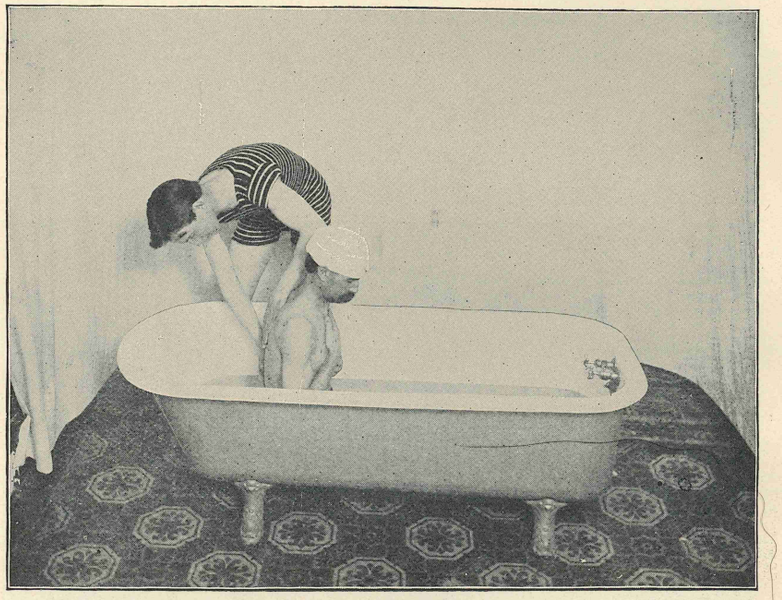


Fig. 41. The Shallow Bath. See page 128.

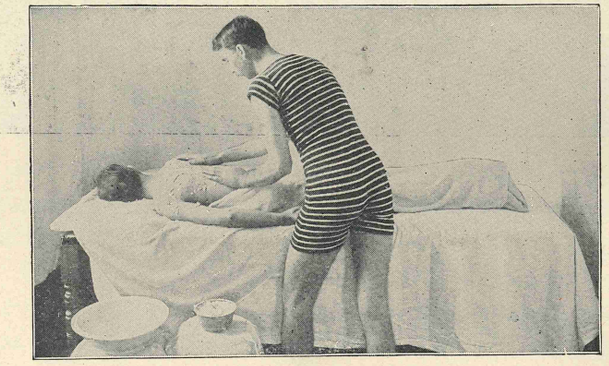


Fig. 42. The Salt Glow. See page 129.

The depth of the water in the shallow bath is ordinarily not more than six inches; if deeper, it interferes with the rubbing.

The *standing shallow bath* is a modification of the bath in which the patient stands in a tub containing water at 75° to 80°. The patient is rubbed by two attendants, one on each side. The water is poured over his spine, chest, and shoulders, at intervals of 15 or 20 seconds. In rubbing the legs, the attendant's hands are constantly dipped in the water, and very vigorous friction is applied, duration 1 to 3 minutes.

At the conclusion of the bath, a pailful of cold water (60° to 55°) is poured over the patient, thus insuring good reaction. He is then quickly dried and vigorously rubbed, after which he should engage in moderate exercise until good reaction is secured.

THE SALT GLOW (Fig. 42)

In this procedure, salt of medium fineness and slightly moistened is applied to the surface of the body with friction movements, the amount of pressure being adjusted to the patient's sensation. With very thin-skinned persons, abrasion and irritation of the skin may be very easily produced. Persons of dark complexion, whose skins are usually thick, bear more vigorous applications than blondes.

The patient prepares for the treatment by lying down upon a slab or bed covered with a sheet, having previously been divested of his clothing. The sheet is drawn over the patient to prevent chilling. One part after another is then exposed and rubbed with the moistened salt, two or three pounds of which should be conveniently at

hand in a basin. When this treatment is given in an institution, the patient may sit upon a stool, lie upon a slab, or stand upon a low stool, while receiving the application, in a room especially arranged for the purpose, and at a temperature sufficiently high to prevent chilling.

After the application, the salt which adheres to the surface is removed by the cold affusion, shower, or spray. The patient is quickly dried and rubbed in the usual manner. It will be noticed that the skin is hard and almost as smooth as marble after this application. In cases of feeble patients, a dash of hot water or a warm shower should be given just before the final cold application.

COLD MITTEN FRICTION (Figs. 43, 44)

By the term "cold friction" is designated a procedure which consists in the application to the surface of the body of a series of partial wet rubbings, one part after another being taken in systematic order until the whole cutaneous surface has been brought into vigorous reaction.

The requisites are: (1) A vessel containing a few quarts of cool, cold or very cold water; ice-water may be employed in many cases. (2) A mitt consisting of rough material of some sort,—ordinary rough linen or Turkish toweling is not desirable. Coarse mohair answers fairly well for the purpose; but the best fabric is a closely woven woolen cloth resembling hair-cloth but slightly rougher to the touch, which is manufactured in Egypt and Turkey, where the author became acquainted with it in the Turkish baths of Cairo and Constantinople. It is there used for a sort of preliminary shampooing applied after the sweating process is completed and before the application

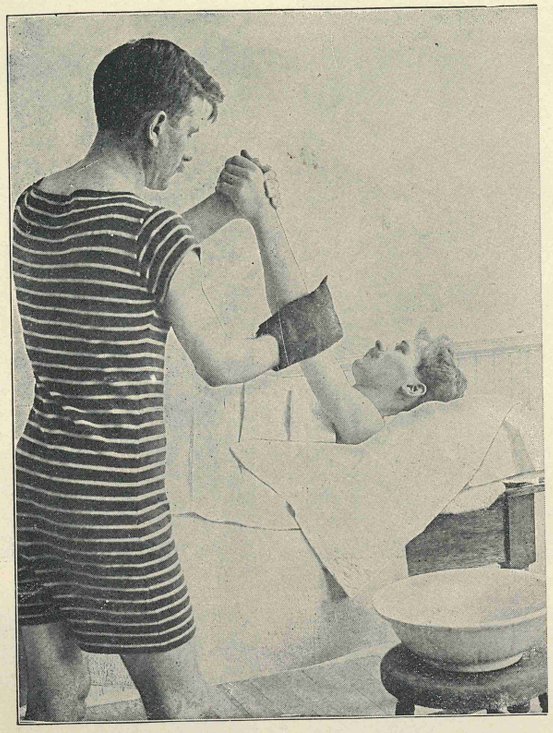


Fig. 43. The Cold Mitten Friction. See page 130.

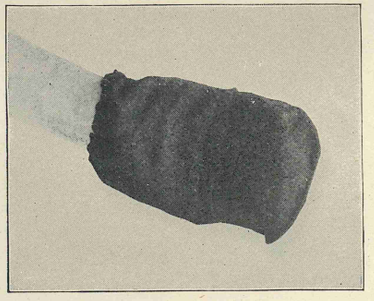
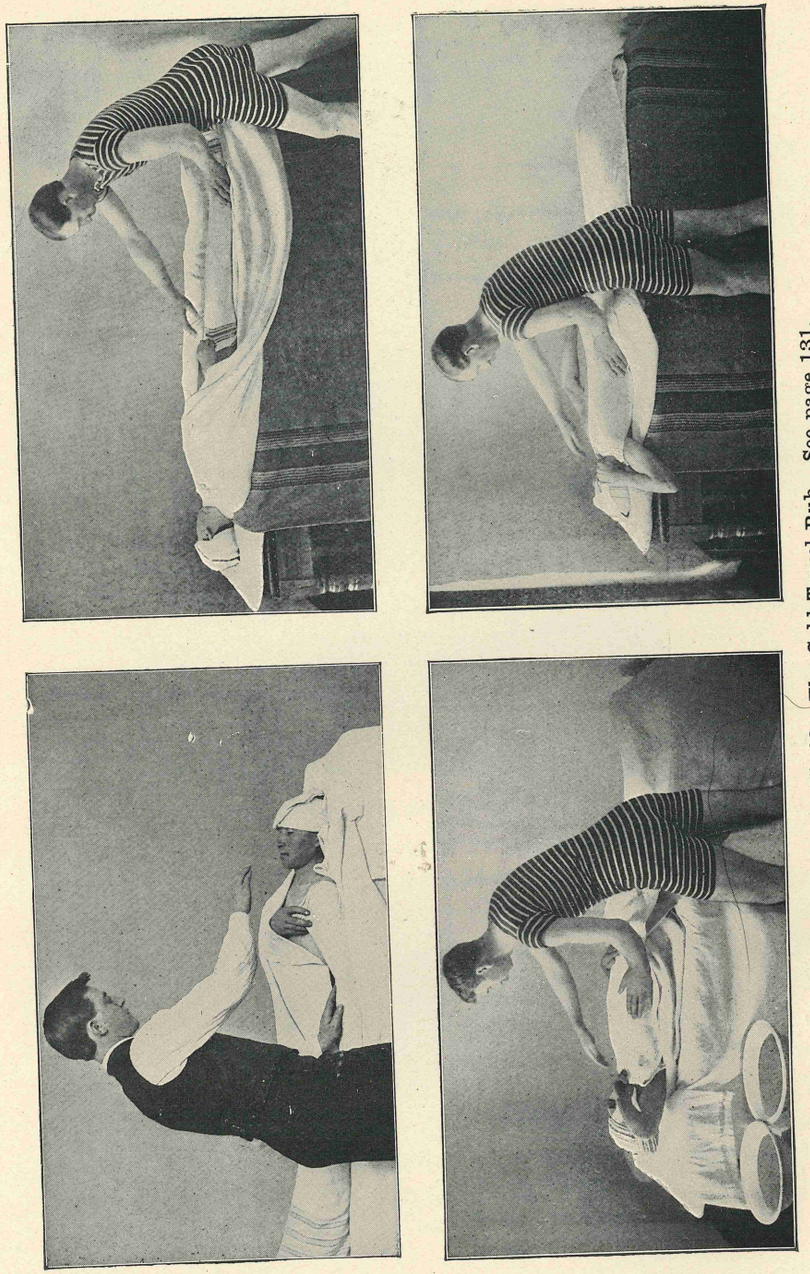


Fig. 44. The Loofah Mitt, for giving the Cold Mitten Friction. See page 130.



Figs. 45, 46, 47, 48. The Cold Towel Rub. See page 131.

of soap. This material possesses just the right degree of roughness, stimulating the skin without irritating it, and is so closely woven that it may be made to hold just the right amount of water for the purpose for which it is designed. (3) A Turkish sheet and one or two towels are also required.

The patient is undressed, and lies upon a bed or a massage couch wrapped in a Turkish sheet. First of all, the head, face, and neck should be wet with cold water. If the hair is not wet (ladies often object to this), a napkin wet with cold water should be placed over the face. The vessel containing the cold water is placed at one side, near the head of the couch; the attendant places the mitt upon the right hand, and then uncovers a small portion of the patient's body, preferably the front of the trunk. He then dips the mitt into the cold water, and proceeds to rub the surface until reddened, redipping the mitt one or more times, covering the whole surface rapidly. Care should be taken to secure reaction in each part before proceeding to the next. Then with his left hand the attendant extends the arm and treats it in like manner, drying rapidly and covering. The other arm is then treated, and then in succession, the legs, and back of the hips, the back of the legs, and lastly the feet. The soles of the feet should be spatted, not rubbed.

THE COLD TOWEL RUB (Figs. 45, 46, 47, 48)

This procedure consists in friction movements made upon a cold wet towel spread out upon the surface.

The requisites are a towel for the head, several linen towels for the application; a sheet and a towel for drying; a pail of water at the temperature desired for the

application, and a basin of water at a temperature ten degrees lower.

The patient should lie in a recumbent position with all his clothing removed, and wrapped in a Turkish sheet and a woolen blanket, a portion of the covering being laid aside so as to expose the portion to which the application is to be made. The head, face, and neck are first bathed with the colder water, in which one of the towels is also wet, and wrapped about the head. A linen towel is then wrung very dry out of the water prepared for the purpose in the pail. After being quickly shaken out, it is applied smoothly to the part to be treated; and with the hands applied in such a manner as to cover as large a portion of the towel as possible, they are rapidly moved from point to point with firm pressure, so as to bring each part of the towel successively in close contact with the skin. The rubbing should be continued until the towel is warm, when it may be removed; the dry towel is then placed upon or wrapped about the part and it is rubbed until the skin is dry and *well reddened by reaction*. The corresponding part of the opposite side is then treated in like manner. If the patient is decidedly neurasthenic, special attention should be given to the back; while if the case is one of cardiac insufficiency, special attention should be given to the chest, arms, and legs.

The hands are rubbed upon the towel, but the towel is not rubbed upon the skin. Particular attention should be paid to this. The effect desired is not produced by mechanical irritation of the skin, but by the assistance rendered the circulation by the intermittent pressure upon the tissues. The hands are applied with long, rapid, alternating strokes, falling upon the surface with sufficient

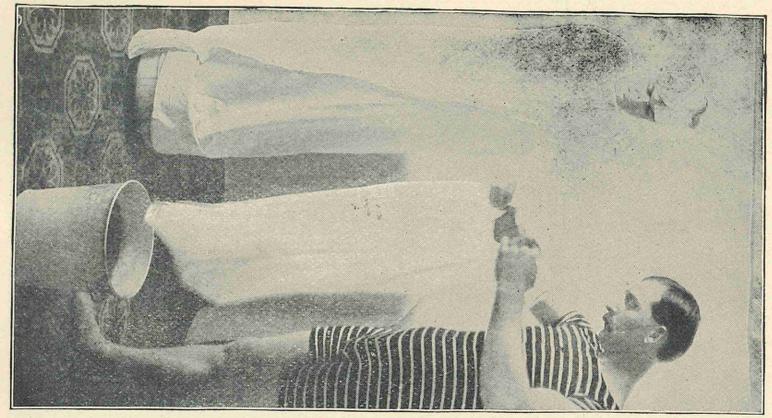


Fig. 49. Preparing the wet sheet.

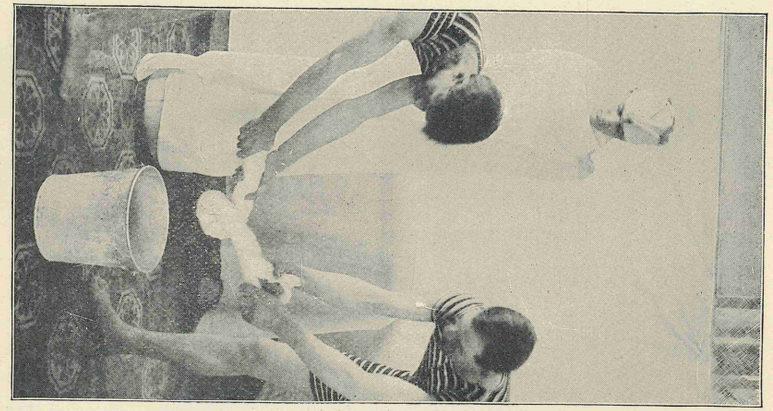


Fig. 50. Wringing the sheet.

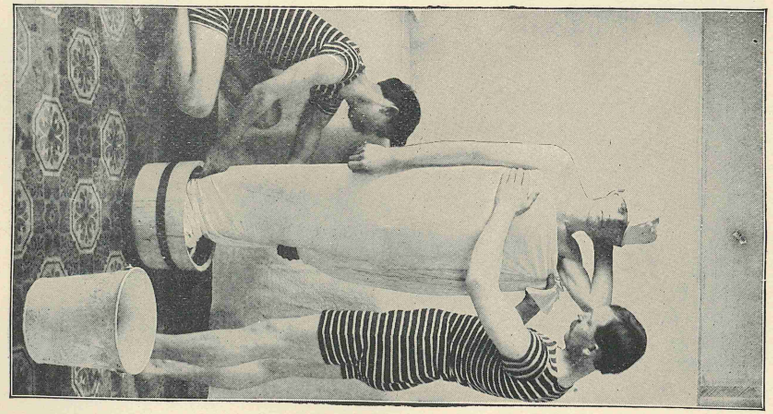


Fig. 51. Application of sheet. First step.

Figs. 49, 50, 51. The Wet Sheet Rub. See page 133.

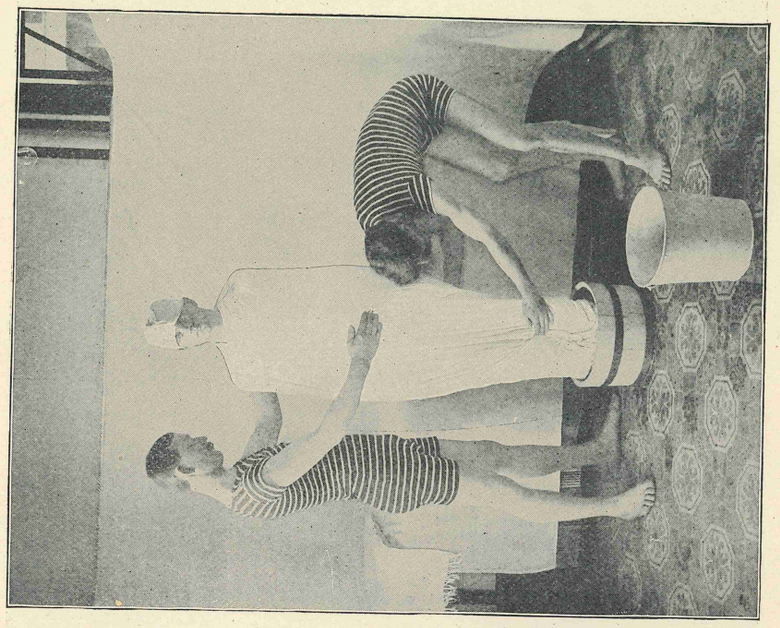


Fig. 53. The patient completely enveloped.

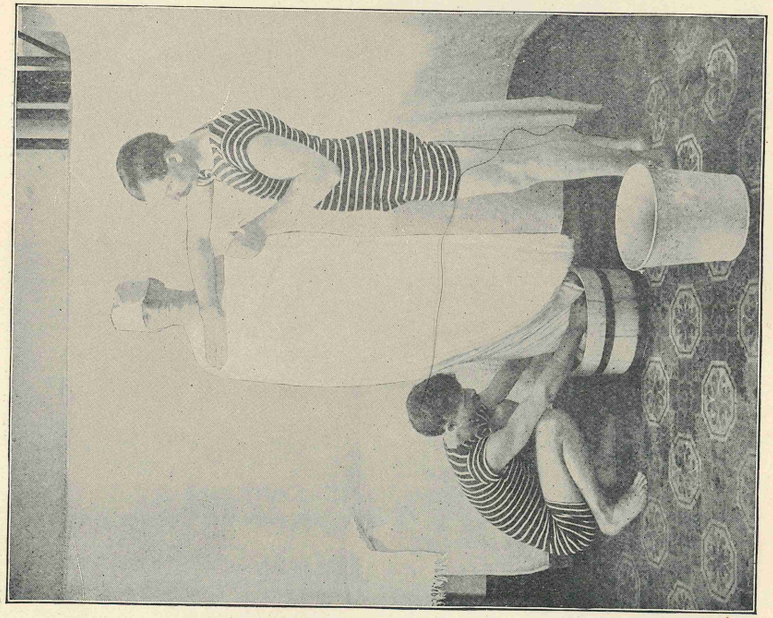


Fig. 52. Application of the wet sheet. Second step.

Figs. 52, 53. The Wet Sheet Rub. See page 133.

force to give a decided percussion effect. The friction movements may be alternated every few seconds with gentle percussion. The whole surface of the towel should be gone over constantly, so as to avoid chilling by evaporation.

In order that the desired therapeutic effect may be obtained, the temperature of the water must be maintained at the initial temperature. This may be accomplished by employing a number of towels, so that no towel is used twice in the same application. A plan which the author prefers as more practical, however, is the following: Two pails or bowls of water are prepared, one of which is ten degrees lower than the temperature at which the application is to be made. The usual temperatures will be 60° and 50°. The face, neck, and head are cooled with the cooler water. After a towel has been applied to a surface and rubbed until warm, it is dropped into the cooler water, where it remains while the part is being dried and rubbed. In preparing the towel for a new application, it is gathered and squeezed, then dipped into the other pail (60°) and wrung out.

THE WET SHEET RUB (Figs. 49, 50, 51, 52, 53)

This procedure, perfected by Priessnitz, consists in a thorough rubbing of the body while enveloped in a wet sheet.

The requisites are a linen sheet, a Turkish sheet, two towels, a tub containing hot water for the feet, a pail of water at 60° to 70°. Water at a higher or lower temperature may be employed when indicated.

The patient, being prepared, the head cooled in the usual way and protected with a cold wet towel, stands in

the tub of hot water with the dry sheet wrapped about him. The attendants prepare the wet sheet, which should be wrung dry enough so it will not drip rapidly.

When the sheet is ready, one assistant, holding one end of the linen sheet properly gathered in the right hand, and seizing the upper left-hand corner with his left hand, steps in front of the patient, while the other attendant withdraws the dry sheet and steps behind to assist. The patient holds up both arms, while the attendant in front places the upper left-hand corner of the sheet under his right arm; the patient then lowers the right arm, holding the sheet in place, while the attendant passes the sheet quickly across the front of the body beneath the left arm, which is then also lowered. The sheet is then carried around the body with the assistance of the attendant who stands behind the patient and pulls the bottom around. As the sheet is brought across the back of the patient, the attendant in front reaches over and seizes the upper edge of the sheet just above the point of the right shoulder, and pulls it first upward, then down upon the patient's chest, while with his other hand he carries the sheet across the chest, covering the fold, and over the left shoulder, deftly tucking the corner under the edge of the sheet behind.

The attendant behind tucks the sheet between the patient's legs, which are then brought tightly together. The sheet is thus brought everywhere in close contact with the skin. As soon as the patient is thus enveloped,—an operation which should be completed in 5 to 8 seconds,—both attendants begin to rub vigorously, covering the whole surface as quickly as possible, one the legs and hips, the other the trunk and arms. The rubbing should be continued for 1 to 3 minutes or until the sheet is everywhere

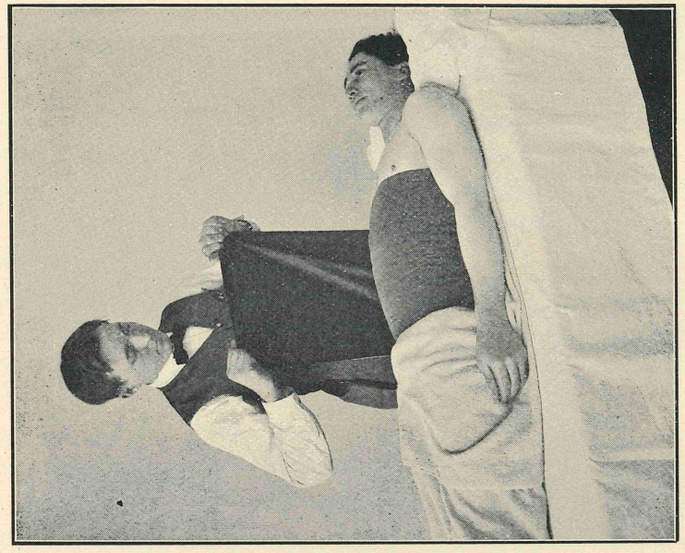


Fig. 56. The Wet Girdle—The application of the outer covering. See page 135.

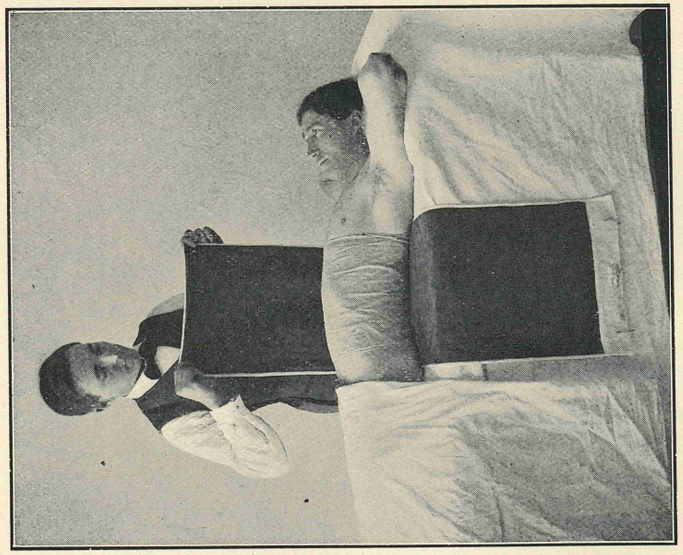


Fig. 55. The Wet Girdle. See page 135.

thoroughly warmed. The attendants should bear in mind that *the patient is not to be rubbed with the sheet, but over the sheet, with downward percussion strokes.*

This is a most excellent procedure for concluding a vigorous electric-light bath, especially with obese patients and fleshy neurasthenics.

THE HALF-SHEET RUB (Fig. 54)

The half-sheet rub is one of the most convenient methods of cooling the skin after a general light bath when tonics effects are desired.

The requisites and preparation of the patient are the same as for the towel bath, except that a linen or cotton sheet is required instead of towels. The half-sheet or folded sheet is wrung dry out of water at room temperature, or 74° F. to 60° F., and is quickly and evenly spread over the patient's body from neck to ankles. The whole surface is then gone over rapidly with alternating long percussion strokes and vigorous clapping movements, until the sheet is well warmed. It is then thrown aside and the patient turns quickly over to undergo the same treatment on the other side. After the bath the patient is well dried and rubbed. The skin should be perfectly dry, smooth and warm before the patient is released.

THE WET GIRDLE (Figs. 55, 56)

The requisites are a linen bandage usually eight or nine inches wide and about three yards in length, or sufficiently long to pass three times around the body; a flannel bandage three or four inches wider; and a waterproof covering of oiled silk or other impervious material.

The application is to be made in accordance with the principles already pointed out in relation to the heating compress. The girdle may be wide enough to reach from the axillæ to the hips, when it is termed the *trunk pack.* In some cases also it is better to reduce the size of the bandage at the start, covering only the abdominal surface instead of passing the bandage around the whole trunk. The impervious covering may be applied or omitted, as indicated.

The wet girdle is only useful when moist. The towel must be boiled daily to prevent eruptions of the skin. It is usually sufficient to use the girdle at night.

When the girdle is removed, always bathe the surface with cold water or alcohol.

THE COTTON POULTICE (Fig. 57)

This consists simply in the application to a part of a mass of dry cotton covered with mackintosh or other impervious material. The cotton is soon moistened by the retained perspiration, and thus the effect of a poultice is obtained, but in a much more cleanly and convenient manner. The cotton poultice is especially valuable in *chronic joint affections.*

THE ALCOHOL RUB

To two parts of cold water add one of proof spirit. Dip the hand in the dilute alcohol, turn the palm quickly upward to prevent loss of the alcohol, and apply to the skin at once. Rub gently, continuing the rubbing until the alcohol is evaporated and the skin normally cool. Witch-hazel may be used instead of alcohol.

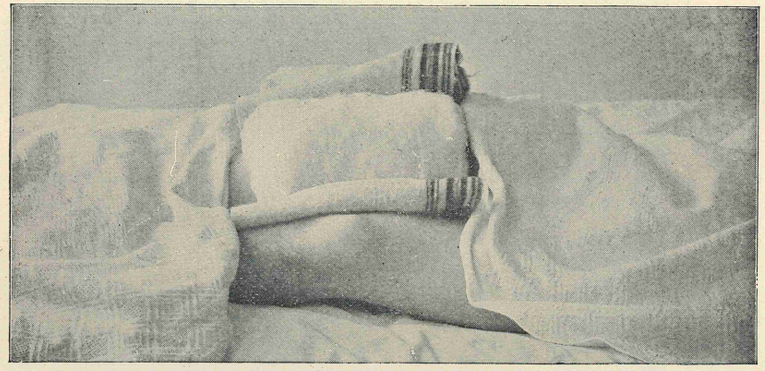


Fig. 57. The Cotton Poultice. See page 136.

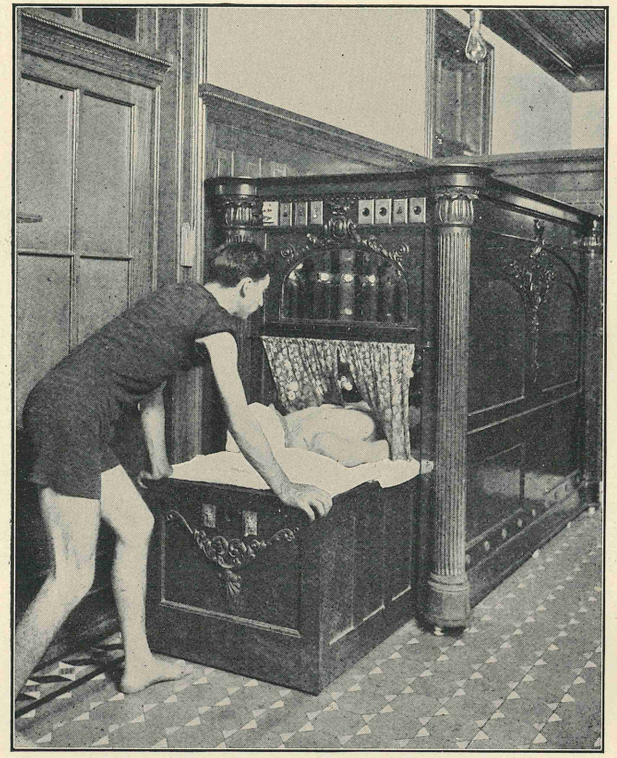


Fig. 58. Horizontal Electric Light Bath. See page 140.

A cologne bottle affords a convenient and more economical means of applying the alcohol.

PHOTOTHERAPY WITH AEROTHERAPY

Cool air, if less versatile as a therapeutic agent, is equally as potent and efficient as cold water. On the whole, it is much more valuable and indispensable. Fortunately, it is the most available and least expensive of all therapeutic agents, at least during the cool season of the year, and during this period may be readily and inexpensively utilized as a most valuable adjuvant to phototherapy. No other apparatus than the ordinary electric fan is required.

THE COOL AIR DOUCHE

This is a most convenient mode of applying cool air therapeutically (Figs. 12, 14). The temperature of the air must be 60° F., or less if possible, but need not be lower than 50° F. It is necessary that a strong air current should be used. This is essential to insure good and prompt reaction. It is more difficult to get reaction with cold air than with cold water, for several reasons:—

1. Air is 3,000 times lighter than water. A cubic foot of air weighs one-third of an ounce, while a cubic foot of water weighs sixty pounds. Hence the force of impact is far less, and a high velocity is needed.

2. The specific heat of air is only about one-fifth that of water, so that a much larger amount is required to produce an equally cooling effect.

3. Air is a very poor conductor of heat, and so re-

quires the most vigorous possible contact with the skin to produce decided effects.

There is a single compensation: dry air takes up moisture readily, and so promotes evaporation, which is a powerful cooling process. Cooling by evaporation, however, is a dangerous and often very harmful method of removing heat from the skin. Ordinary cooling by evaporation contracts the vessels of the skin but aborts reaction. Its effects are not sufficiently intense to awaken a reflex response from the spinal cord. Hence the chilling and other disagreeable effects produced, and the resulting rheumatic and neuralgic pain, with perhaps worse consequences growing out of visceral congestion.

These untoward effects are prevented by making the air blast cold enough and forcible enough to make a decided stinging effect upon the skin. Reaction comes promptly, especially if the peripheral circulation is encouraged by rubbing of the skin by an attendant, or better, by the patient himself. The writer has for years made use of this means of cooling patients after the electric-light and other warm baths, and has seen no ill effects. It is a certain preventive of "taking cold" on going out after the bath.

For general cooling effects the patient stands before a strong electric fan and turns his body while rubbing himself until the skin is dry and cool, which requires usually not more than one or two minutes.

A better plan is to arrange four fans so as to concentrate the currents in the center of the space between them. The patient stands in the vortex of the currents, rubbing himself vigorously, and feels no uncomfortable sensation although being rapidly cooled by evaporation.

THE COLD-AIR RUB

The patient, after undressing, enters a chamber the temperature of which is 60° F. or less. Here he is rubbed vigorously (Fig. 12) with friction mitts such as are used for cold-water friction baths (Fig. 44).

With strong persons, the whole body may be exposed while the attendant rapidly but systematically goes over the whole skin surface with the friction mitts, making long and vigorous sweeps lengthwise of the trunk and limbs.

The patient must dress and undress in a warm room. Feeble patients should be covered well during the treatment, an arm or leg or other small area being exposed in succession for treatment.

This is an excellent measure for producing cooling and tonic effects after a vigorous electric-light bath.

THE CABINET AIR-DOUCHE

A more effective arrangement for obtaining the most pronounced effects is the cabinet air-douche (Fig. 14). The patient sits or stands in a small chamber or cabinet in which is a large fan or several small ones so placed as to expose the whole surface of the body to a strong current of cool or cold air. The purpose of the cabinet is to confine the cold air to the space necessary and thus prevent cooling of the adjacent room in which the patient is prepared for the bath.

This arrangement permits the employment of air at a temperature much lower than that of the ordinary room temperature. This is easily arranged in cold weather by a connection through a suitable conduit with the out-of-door air. In the warm season, the air may be cooled by means of ice or the evaporation of water.

The patient must dress and undress in a warm room. During the exposure the surface must be constantly rubbed either by the patient or by an attendant.

The duration of the bath will be 30 seconds to two minutes, according to the temperature of the air and the vigor and endurance of the patient. The bath should never continue so long as to produce a mottled appearance of the skin or pronounced chilliness.

The bath should be followed by massage or rubbing with oil in a warm room, to insure thorough reaction.

The patient may expose himself to the electric-light bath either before or after the air bath, or in alternation with it. Arc or incandescent lamps may be arranged in the cabinet.

COMBINATIONS OF THE ELECTRIC-LIGHT BATH WITH HYDRIATIC APPLICATIONS

ELECTRIC LIGHT BATH WITH SHOWER AND SHAMPOO (Figs. 58, 59, 60)

After thorough heating of the patient in the electric-light bath, as shown by the production of perspiration, the patient is removed from the bath and a shampoo is administered, either upon an ordinary shampoo slab or in a tub if the slab is not available. It is important to apply to the surface, immediately after removing the patient from the bath, water at a temperature of about 90°, so as to secure a slight toning up of the surface. The whole surface of the body is gone over, first with the bare hands, rubbing and kneading the tissues so as to remove the cuticle, and continuing the process until the skin is smooth. The surface is then gone over with soap and a

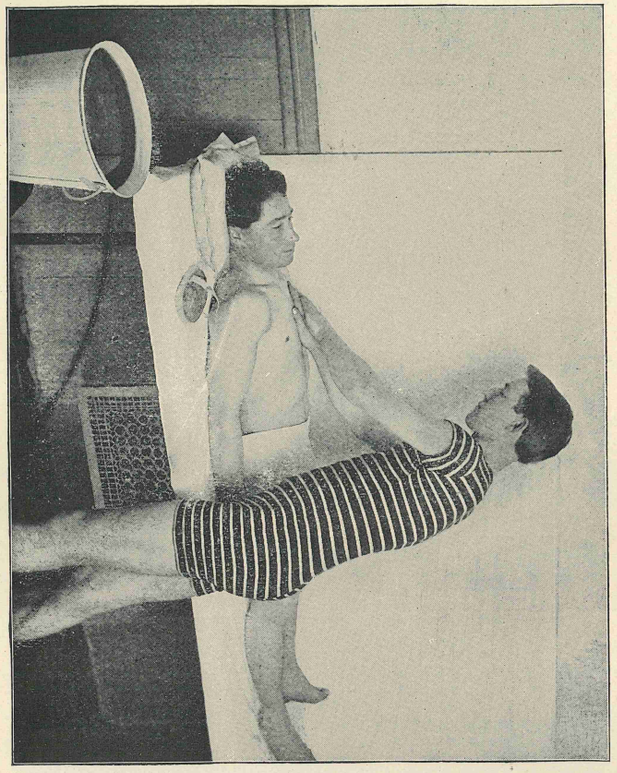


Fig. 59. The Swedish Shampoo. See page 140.

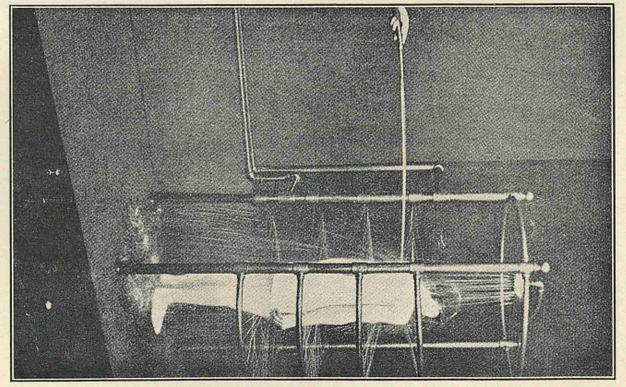
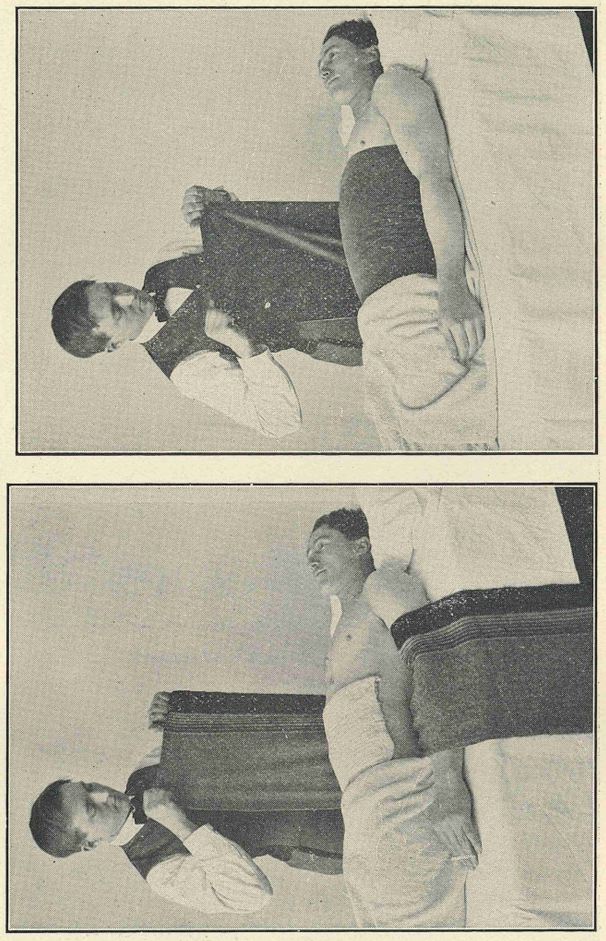


Fig. 60. The Shower. See page 140.



Figs. 61, 62. The Abdominal Heating Compress. See page 142.

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shampoo brush or a properly prepared loofah. After the shampoo, the shower is administered, beginning with a temperature of 95° F. to 100° F., and gradually lowering to 80° F. A dash of water at ordinary pipe temperature is given just at the close of the bath to secure a good reaction.

Fuller directions for the shower bath, the douche and other forms of bath will be found in the author's work, *Rational Hydrotherapy,* pages 426 and following.

A soap shampoo is not required more than once a week, and hence may be omitted when the patient is receiving daily treatment, the light bath being immediately followed by the shower. Whenever soap is used, a little fine vaseline, oil, or massage cream should be applied after drying the skin.

It is especially important to see that the skin is thoroughly dry and smooth before the patient leaves the bathroom, so as to obviate the danger of contracting cold.

This is one of the most useful of all therapeutic procedures. Its application is very wide. It may find a useful place in the treatment of almost every form of chronic disease. It is only contraindicated in cases of extreme weakness, advanced arteriosclerosis, cardiac disease with loss of compensation, and advanced renal disease.

THE ARC LIGHT OR PHOTOPHORE WITH ICE RUBBING

At the conclusion of an application of the arc light or photophore, a cooling application of some kind should always be administered. The ordinary application is cool water, diluted alcohol or witch-hazel, applied with the hand, a sponge or a wet cloth. When it is desired to obtain more stimulating effects, a smooth piece of ice

may be rubbed quickly over the surface. In cases in which a still more stimulating application is desired, the ice rub may be made at frequent intervals during the application.

THE LIGHT BATH WITH THE CARDIAC COMPRESS

When the general surface is cooled during a light application, it is not necessary to give special attention to the heart, as the heart will profit by a tonic reflex from the entire surface of the body; but in general light applications, and in applications of the thermophore or the photophore to extensive areas, it is necessary to take the precaution to protect the heart by the cold precordial compress or an ice bag placed over the heart. In some cases it is also necessary to apply a cold application about the neck as protection for the brain.

THE ARC LIGHT OR PHOTOPHORE WITH THE HEATING COMPRESS

When prolonged derivative or resolvent effects are required, as when the application is made for relief of deep visceral congestion or to stimulate the circulation through a deep-lying organ as in cirrhosis of the liver, to relieve deep-seated pain or to stimulate absorption of chronic exudates from inflammation about a joint, chronic pelvic disease, pleuritic effusions and allied conditions, it is well to follow an application of the arc light or the photophore by the heating compress (Figs. 61, 62). This is applied as follows: A towel or cheesecloth compress is wrung dry out of cold water (60° F. to 70° F.) This moist compress is applied to the skin. Then it is covered with a piece of mackintosh large enough to extend beyond the

moist cloth an inch or two on all sides. Several thicknesses of flannel are then applied and bound tightly in place by means of a snug bandage. The purpose is to secure quick heating of the cool compress and retention of heat, so that the effect of a poultice is obtained.

The heating compress should be applied at once at the termination of the light application while the surface is still red and warm. The heating compress may be left in place for twelve to twenty-four hours. When it is removed the surface should be bathed with alcohol. The heating compress, once heated up, should not be allowed to become either cold or dry. At the first indications of cooling or dryness, the bandage should be removed. The good effects of the arc light or photophore are enormously increased by following the application with the heating compress.

THE PHOTOPHORE TO THE FEET WITH GENERAL COLD HYDRIATIC APPLICATIONS

In making general cold hydriatic applications, it is always necessary that the feet and legs should be well warmed so as to promote good reaction. If this precaution is neglected, headache and other disagreeable symptoms are likely to be induced and the good effects desired are not secured.

The photophore is one of the most excellent and convenient means of heating the feet and legs in preparation for a cold-mitten friction, a cold-towel rub, the salt glow, or any other similar tonic application. Its use is very much more convenient than the hot foot bath, especially in cases of bedridden patients.

For use in the wards of a hospital, it would be impossible to devise a more convenient method of warming the feet than the photophore. The great advantage of the photophore over the thermophore and other means of heating by contact is the fact that the heat rays penetrate the deep tissues and stimulate the heat-making processes of the tissues, whereas the effect of other means of heating is simply to warm the surface while at the same time reflexly inhibiting or depressing the heat-making functions of the parts to which the application is made.

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VII.

Clinical Phototherapy

THE experience gained in the employment of phototherapy in its varied forms at the Battle Creek Sanitarium, where this agent enters into the therapeutic program of four or five thousand patients yearly, and at the large dispensary of the American Medical Missionary College in Chicago, where many hundreds more are treated, together with the published experiences of many hundreds of physicians who are now making regular use of phototherapy in hospital and private practice, affords ample ground for the statement that this agent must be classed among the great recent advances in modern therapeutics.

FEVER CONVALESCENTS

The general electric-light bath, also the arc light to the spine, may be employed with great advantage in cases of convalescents from typhoid fever and other infectious fevers. It is one of the most effective means of combating the anemia and malnutrition resulting from the prolonged action of fever toxins upon the blood and tissues. The application must be short, and should be followed by short tonic hydriatic applications, such as the mitten friction or towel rub. The application of the arc light over the liver and spleen followed by ice rubbing is a most useful means of hastening the return of these organs to the normal condition after febrile attacks.

MALARIAL CACHEXIA

Short applications of the electric-light bath followed by the very short cold douche or, in the case of fever patients, milder tonic applications, are most effective means of combating the cachexia which results from chronic malarial infection. The general light application should be short. As soon as the patient begins to perspire, he should be removed from the bath, and the cold application should follow immediately while the skin is still warm. Applications of the arc light or the photophore should be made daily over the liver and spleen, which are nearly always found enlarged in this condition. The arc light is much preferable to the photophore, as its rays are more penetrating. The thermophore over the liver, spleen and abdomen is also a useful measure in these cases. It should be followed by the wet girdle, to be worn overnight.

LIGHT BATHS AFTER SCARLET FEVER

The anemia which often follows scarlet fever, especially in cases in which the kidneys have been involved, is a condition to which light baths are particularly applicable. The arc light is in these cases preferable to the incandescent light bath because of its more powerful influence upon the skin. The applications should be short, and should be made to cover the entire surface by successive seances until the whole skin has been gone over and is thoroughly tanned. The application should, of course, not begin until after the acute congestion produced by the disease has subsided, for Cnopf has shown that the actinic rays are highly pernicious in scarlet fever. He believes, on the other hand, that the red rays

are distinctly curative. As to these effects Cnopf says:

"The effect of the red light treatment of scarlet fever is twofold. The fever, which under ordinary treatment usually persists until the rash fades, falls, almost by crisis, and reaches normal in three or four days, instead of in seven or eight days, as is the case under ordinary treatment. The skin lesion is also markedly affected, the red color so characteristic of the disease gradually fading. The complications of the disease are apparently not affected, as in several cases secondary angina or pneumonia served to cause an increase in the fever as usual."

CACHEXIAS DUE TO TOXEMIA

A large share of the maladies formerly attributed to uric acid are now known to be due to the disturbing influence of subtle poisons generated in the intestine and absorbed into the blood. So long as the body is able to oxidize and destroy these poisons or eliminate them, no unpleasant symptoms appear; but sooner or later the tissues become saturated with toxins; the power to oxidize and eliminate them is diminished, and by their accumulation most profound disturbances are produced.

Experience shows that the general application of light either by means of the electric-light bath or the arc light is extremely useful in promoting recovery. In this whole class of disorders, as pointed out years ago by Bouchard in his interesting volume, *Renseignement de la Nutrition,* there is slowed metabolism, decreased oxidation, deficient elimination of waste matters, depreciation of the blood and tissues in general. The effect of retention of these poisons is to produce

spasm of the surface vessels with resulting visceral congestion.

General Light Applications are of greatest value in relieving all these conditions. Under the influence of the thermic rays of the electric-light bath, the general surface vessels are relaxed, thus relieving visceral congestion. By repeated applications of the arc light, this relaxation of the surface vessels and the improved circulation through the skin may be rendered permanent through the production of solar hyperemia. The arc light applications should be made daily or in alternation with the cabinet bath, and the entire surface should be gone over in successive applications until the skin is well reddened.

The arc light, the photophore and the thermophore render the greatest service also as measures of relief and cure in neuralgia, myalgia, arthropathies and various other painful and disabling local affections which are encountered in this class of disorders. In general, these local applications should be made daily. The duration should be from five to twenty minutes. The effects may be greatly enhanced by the application of a heating compress after the light application.

It must be remembered, of course, that these applications, whether general or local, deal only with the symptoms and results of the disease, and do not affect the cause, which must be sought out and removed. These patients should always be advised to live outdoors as much as possible, to arrange outdoor sleeping rooms, or at least to sleep with the windows wide open at all seasons. Most of all it is important that the patient should be instructed to adopt an antitoxic dietary and to make

use of yogurt. Intestinal activity must be increased to the extent of securing at least two thorough evacuations daily. This may be best accomplished by means of the use of laxative foods.

DIABETES

This is a disease of diminished oxidation. General applications of the electric light are of special value in stimulating the oxidation processes of the body. The penetrating thermic rays increase oxidation by exciting the activity of the thermogenic tissues in the muscles; hence it is important that the light should be applied in such a way as to reach the largest possible area of the muscular structures. If the horizontal cabinet is used, the patient should lie half the time upon the face so that the great muscular masses of the back and thighs may be brought fully under the influence of the thermic rays. In employing the arc light, the application should be made as intense as the patient can endure, and the whole surface of the body should be exposed to the influence of the rays in successive applications. About half the surface should be gone over at each seance.

Light applications in diabetes should be made daily, and the duration should be fifteen to thirty minutes. Strong patients may receive two applications daily. There is creditable data for believing that under the influence of the electric-light bath, sugar oxidation may be increased to such a degree as to burn up the sugar at the rate of at least an ounce every thirty minutes.

It is especially important in this disease to avoid the depressing effects of overheating the skin; hence the skin surface should be cooled during the bath by the

electric fan or other means, as has been pointed out elsewhere (see p. 137).

The good effects of the light bath in diabetes may be greatly enhanced by a prolonged tepid or cool bath immediately following. Patients of ordinary strength may with great advantage spend fifteen to thirty minutes in the swimming pool. Both the exercise and the low temperature of the water are effective means of stimulating oxidation and hence encourage the combustion of sugar in the tissues. In the absence of the swimming bath, an ordinary shallow bath may render effective service. The bath is administered in an ordinary bathtub. The temperature of the water should be about 80°. After a little training, a lower temperature may be employed. The patient sits in the bathtub and rubs his legs vigorously with both hands at frequent intervals, dashing the water up around the trunk and arms, and rubbing these parts. The rubbing should be sufficiently vigorous to prevent chilling of the surface or the appearance of goose-flesh. The patient may work as hard in the bathtub as in a swimming pool, and thus may get the same benefit, although in a less agreeable manner. The whole body should be submerged in the bath with the exception of the head, so as to produce a strong tonic effect upon the entire surface. The rubbing should be continued during the submergence.

If the patient is not strong enough to rub himself with sufficient vigor, he should be rubbed by an attendant. The services of an attendant are always advantageous.

Light applications are of very great service in various complications which are encountered in diabetes, par-

ticularly the following conditions, in which special local applications should be made as indicated, in addition to the general applications above described:—

Sciatica.—The arc light should be applied daily to the lower part of the back and along the course of the sciatic nerve. The photophore and the thermophore are also useful in these cases. When both legs are affected, the half electric-light bath may be employed, the patient lying upon the face. The application should be as intense as the patient can bear, and the duration should be ten to twenty minutes, or until the skin is very deeply reddened and the pain decidedly mitigated.

The application of radiant heat is much more effective in these cases than ordinary hot applications because of the penetrating power of the rays, which easily reach the affected nerve trunks as well as the overlying skin. In severe cases, the best results are obtained by the application of the arc light in such a manner as to produce very decided erythema.

Rheumatic Pains.—Local applications of the arc light, photophore and even the thermophore are very effective in relieving rheumatic pains in the joints or the muscles. It is well to follow the light application by the heating compress (see page 142).

Obese diabetics may receive much more vigorous applications than those who are thin. The duration of the light applications may be increased to twenty or thirty minutes, and afterward the cooling bath may be equally prolonged with advantage.

At the conclusion of the application, the surface

should be rubbed with ice, or if the skin is very sensitive, alcohol may be applied instead, gently rubbed on with the hand. After the light application, either the heating compress, well covered, or a cotton pack should be applied.

Furunculosis.—The general lowering of vital resistance which occurs in connection with diabetes invites infection of all sorts. One of the most common forms of infection manifests itself in the occurrence of boils. The most effective means of combating this very unfortunate symptom is the arc light followed by cooling applications. The application of the arc light should not be sufficiently prolonged to produce erythema, but to stimulate the circulation through the skin. By thus encouraging leucocytosis, the further extension of the infection will be combated.

Assfalg in ten light treatments varying from one-half to three-quarters of an hour in duration completely cured a case of furunculosis of the entire back and chest which had been present four years and which had resisted all other treatments. There was no return within nine months.

Axmann reported cures of furunculosis under the light treatment.

Bronchitis.—This condition, which often exists in connection with diabetes, is greatly relieved by thorough applications of the arc light to the chest, before and behind. By producing a decided erythema of the skin, the cough and expectoration may be relieved to a very marked degree.

Gangrene.—There is no better means of combating gangrene of the extremities than the photophore and the arc light. The arc light is particularly beneficial. The application should begin as soon as there is the slightest symptom of disturbed circulation in the feet. In fact, it is well to give special attention to the feet in all cases of diabetes as a precautionary measure. The arc light should be applied for three to five minutes at a temperature as high as can be borne. A little cold water should then be dashed over the feet, or, if this measure cannot be conveniently employed, they may be cooled by means of a towel dipped in cold water or by alcohol rubbing. Another excellent plan is to rub the feet and toes quickly with a smooth piece of ice at intervals of half a minute during the application of the arc light.

The writer has often succeeded in arresting progressive gangrene by this means. It is quite possible that the actinic rays of the arc light act beneficially by destroying the bacteria which are active in this condition.

Cirrhosis of the Liver.—This condition, not infrequently present in diabetes, is not, of course, curable, but it is possible, nevertheless, to greatly mitigate the evils resulting from hepatic cirrhosis by means of the arc light, and even by the use of the photophore and the thermophore. By the arc light a strong erythema may be induced over the liver and the entire abdominal surface. This dilates the surface vessels and so increases the size of the systemic outlets of the portal circulation.

OBESITY

Obesity is a disease akin to diabetes. In this affection there is a deficient oxidation of fats. Oxidation may

be increased by the same methods suggested in diabetes. The application may be more prolonged and the following cold bath should also be prolonged. It is important to use cooling measures in connection with the light applications, so as to avoid the depressing effects which would otherwise result.

In cases of local obesity, as about the hips or abdomen, the arc light, the photophore and the thermophore are all effective measures. The photophore and the arc light are most efficient. The light should be as intense as the patient can bear. Frequent or continuous cooling of the surface treated is necessary to secure the best results. At the close of the application, the surface should be rubbed with ice, and the heating compress should be applied, to be worn until the next treatment. Massage and special gymnastics are also essential for the best results.

Rheumatic pains in the muscles and joints and neuralgic pains in the sciatic and other nerves to which obese patients are subject should be treated as elsewhere directed. (See *Diabetes,* page 151.)

By sufficiently intense application, fat may be burned up in the electric-light bath at the rate of at least an ounce every thirty minutes. Walking at the rate of three miles an hour will consume an equal quantity of fat in the average patient, and an equal amount may be burned by a cool shallow bath combined with rubbing, continued for twenty to thirty minutes. (For directions for giving the shallow bath, see under *Diabetes,* page 150.)

SCURVY — PURPURA

The electric-light bath is an excellent means of combating the various conditions which are included under

this head. The cabinet bath should be short, should never be allowed to continue after the patient begins to perspire, and at the beginning should stop short of perspiration. As soon as the skin is well heated, the patient should be removed from the bath, and a very short cold application should be made. The mitten friction, the cold-towel rub, the salt glow or a half-sheet rub are the most effective means. It must not be forgotten that this disease is one of malnutrition and hence requires proper regulation of diet. Flesh meats of all sorts should be excluded. The diet should be strictly antitoxic. It is especially important that the patient have an ample supply of raw food, such as yogurt buttermilk, orange juice, fresh apple juice, lemon juice and, when the digestive organs will permit, raw celery, lettuce, and raw fruits of all sorts. Ripe bananas prepared by rubbing through a colander are excellent in these cases.

Special attention must be given to the bowels, which in these cases abound in anaerobes, that is, toxin-forming bacteria, and especially putrefactive organisms. Active peristaltic activity should be assured by a laxative and antitoxic diet.

CHRONIC GASTRITIS

Patients who have long suffered from chronic gastritis generally show marked indications of chronic autointoxication, both intestinal and metabolic; hence general tonic applications of the electric-light bath are of great service. This should consist of the cabinet bath or the application of the arc light to the spine, followed by short cold applications, such as the mitten friction or the towel rub.

In addition, local applications of the arc light or of the photophore should be made over the stomach and the spine opposite. The production of decided erythema over the anterior surface of the body, covering an area from the fourth rib to the umbilicus and extending to the axillary line on each side, is a most effective means of combating the congestion of the gastric mucous membrane which exists in this condition. Also the wet girdle should be applied after each application. The photophore and the thermophore may be used in connection with the arc light with advantage, especially in cases in which there is painful digestion. The application of the thermophore or the photophore for half an hour after meals when pain is most likely to occur will generally afford relief. When there is referred tenderness of the spine, the photophore or the thermophore should be applied to the sensitive area. The half electric-light bath applied to the lower extremities and followed by cold rubbing of the legs is an excellent derivative measure. An antitoxic diet should be employed.

HYPOPEPSIA OR HYPOHYDROCHLORIA

In this case there is usually a great lowering of vital resistance and frequently marked evidences of cachexia. In a large proportion of cases, the hypopepsia is the result of chronic gastritis; hence the same measures are indicated as in chronic gastritis. The patient must adopt a strictly antitoxic diet, and it is important to limit the use of fats, and especially of animal fats, to the smallest amount required for proper nutrition. In the majority of cases, the limitation of fats to 300 or 400 calories daily will be found decidedly beneficial. Vegetable fats are

better tolerated than animal fats. The antiseptic properties of the gastric juice have been lost or greatly reduced by deficiency of free hydrochloric acid, hence it is important in these cases to employ yogurt tablets as intestinal antiseptics. General tanning of the skin by means of the arc light produces excellent results in these cases.

Flesh foods should be strictly prohibited because of the inability of the stomach to digest flesh foods or to destroy the putrefactive bacteria which flesh foods always contain. Buttermilk is useful in these cases when the stomach is not so sensitive as to show intolerance to the lactic acid which it contains.

HYPERPEPSIA OR HYPERHYDROCHLORIA

Prolonged electric-light cabinet baths are of great service in this condition. The bath should be applied in such a way as to produce vigorous perspiration. The best time for the bath is an hour before eating, or soon after eating. By producing marked hyperemia of the skin and especially by removing a large amount of chlorid of sodium, the secretion of hydrochloric acid is diminished. The pain often present in this condition may be relieved by the application of the arc light, the photophore and even the thermophore to the spine and the epigastric region. It is well to produce a decided erythema over the stomach. This condition is quite generally associated with intestinal autointoxication. In these cases, the patient is emaciated and the skin tawny. The diet should be strictly antitoxic. Flesh foods must be absolutely forbidden because of their exciting effect upon the gastric mucous membrane, as shown by Pawlow.

CONSTIPATION

This is perhaps the most prevalent of all disorders among civilized people, and is probably a more prolific cause of chronic disease than any other. The autointoxication which necessarily results from the too long retention of putrefying food remnants in the intestine lays the foundation for degeneration of blood-vessels, nerves, glands and every bodily tissue, and thus becomes a veritable mother of maladies. Bright's disease, degenerations of the liver, spleen, arteriosclerosis, apoplexy and a multitude of other maladies are attributed by Combe and other authorities to the intestinal autointoxication which results from constipation.

The electric-light bath is capable of rendering very great service in the treatment of this condition. The general electric-light bath aids greatly in the elimination of the toxins with which the tissues of constipated persons are saturated. Light baths also stimulate the oxidation of these waste and toxic matters. It should be remembered, however, that prolonged sweating tends to produce constipation; hence the sweating bath should be preceded and followed by copious water drinking; an extra glass or two of cold water should be taken at night before retiring and on arising in the morning.

General light applications should in this condition be made at least three times weekly, and in addition daily applications of the photophore or the arc light should be made to the abdomen, being followed by ice rubbing of the skin over the abdominal surface. The wet girdle should be applied at night. In addition to the above, it is important that a very laxative and antitoxic diet should be employed.

GASTRIC ULCER

For this condition the general measures recommended for hyperhydrochloria should be employed in connection with a proper dietary. Applications of the thermophore or the arc light should be made over the anterior surface of the body from the fourth rib to the umbilicus two or three times a day, and the heating compress should be employed during the intervals.

NERVOUS DYSPEPSIA

This condition is generally associated with general malnutrition. In many cases hyperhydrochloria exists. Short electric-light baths may be used daily, followed by appropriate cooling measures, especially the cold-mitten friction or towel rub, or the half-sheet rub. Spinal tenderness or pain is best relieved by the arc light or the photophore; for relief of cold extremities, use the arc light or the photophore followed by ice rubbing and friction.

CHRONIC APPENDICITIS

The general vital resistance may be improved by employing the electric-light bath followed by cool mitten friction two or three times a week and daily local applications of the photophore, or better, the arc light. The applications should be sufficiently intense to produce decided erythema over the lower right portion of the abdominal surface.

Careful attention must be given to diet. It is especially important to exclude flesh foods. The putrefactive bacteria introduced by flesh food, and the decompo-

sition of undigested remnants of meats in the cecum, are without doubt active contributing causes to the production of this disease.

Free evacuation of the bowels should be secured daily by the use of laxative and antitoxic foods, as chronic anærobic infection of the intestine always exists in these cases.

JAUNDICE

The biliary deposits in the skin and the resulting irritation are best relieved by the electric-light bath. Local applications of the arc light or the photophore may be made over the liver, these applications to be followed by the wet girdle to be worn overnight. Intestinal autointoxication is nearly always present in these cases, and requires an antitoxic diet and laxative foods.

CIRRHOSIS OF THE LIVER

This condition is of course incurable, but it may be greatly mitigated by the use of tonic applications of the electric-light bath two or three times a week, and the arc light over the region of the liver and the abdomen with sufficient intensity to produce decided hyperemia.

An antitoxic dietary should be closely followed to combat the intestinal autointoxication which exists in these cases. No flesh should be eaten; the most laxative and antitoxic foods should be employed.

CHRONIC NEPHRITIS

It is now generally recognized that this infection is in the majority of cases the result of the long continued

action of toxins produced in the body in excessive quantities. The most common source of these toxic substances is the intestinal canal, where they are the result of the putrefaction of proteins. The use of flesh foods, even of eggs in excessive quantities, may be a cause of these putrefactions; hence in the treatment of this disease, reliance should not be placed upon the electric-light bath or any other measure which deals only with the symptoms or the results of the malady, but an effort should be made to remove the cause.

The diet should be thoroughly antitoxic; meat should be wholly excluded.

The electric-light bath may be used two or three times a week with advantage. It should always be followed by careful cooling of the skin by means of the cold-mitten friction, or the alcohol or witch-hazel rub, or the neutral bath. The arc light may be advantageously used in these cases as a means of overcoming the spasm of the vessels of the skin which nearly always exists. Applications of sufficient intensity to produce erythema may be made over the entire body at successive seances. It is most gratifying in these cases to see how great improvement may be secured by a proper regulation of the dietary in combination with electric-light baths.

NEURITIS

This disease, from whatever cause, may generally be greatly relieved by light applications. The penetrating thermic rays afford relief from pain when other measures fail, and thus obviate the necessity for the use of opium and other pain-relieving drugs, which generally leads to most disastrous results in chronic cases of this sort as

well as in all forms of chronic pain. The arc light and the photophore are the most effective measures. The thermophore is sometimes useful also. General light applications may be made several times a week with advantage as a means of improving the general nutrition. The intestinal toxemia which is a most common cause of this condition must be combated by an antitoxic diet, by the use of yogurt tablets, and by securing thorough and regular evacuation of the bowels. In the majority of cases, the patient is benefited by securing at least two free movements of the bowels daily. This must be accomplished by the use of a laxative and antitoxic diet. Flesh foods and stimulants should be excluded from the dietary.

After local applications for the relief of neuritis, it is generally best to apply the heating compress so as to continue the beneficial effects secured.

Rockwell (*New York Medical Record,* Nov. 9, 1907) considers phototherapy far more efficacious than any other therapy in the treatment of neuritis. He reported ten cases of neuritis treated in this way with marked benefit.

NEURALGIA

Substantially the same measures as have been recommended above for neuritis may be employed with equal success in neuralgia. In chronic cases, a strong hyperemia of the skin should be produced over the affected part in cases in which the pain does not readily yield to milder applications. The effects of the application may be prolonged by the heating compress described on page 142.

CHRONIC MYELITIS AND SPINAL SCLEROSIS

It is of course too much to expect a radical cure of organic disorders of the spinal cord, but light applications are certainly effective in greatly mitigating the condition of these patients. In most cases a judicious employment of light baths in connection with hydrotherapy, regulation of diet and other hygienic measures, will be found effective in arresting the disease. Not infrequently a very considerable degree of improvement can be secured. In patients who are fairly strong, the electric-light cabinet bath should be employed at least two or three times a week in such a manner as to secure vigorous perspiration, after which the tonic cold application should be made, such as the wet sheet rub, the cold mitten friction or the salt glow. The arc light may be applied to the spine with great advantage. A cooling measure should be used at the same time so that the application may be made as intense as possible. Excellent derivative effects may be secured by producing decided erythema of the skin. The antitoxic diet should be employed in connection with yogurt tablets and whatever measures may be needed to secure free intestinal activity. This is very essential for the reason that there is considerable ground for believing that many organic affections of the spine are the result of the absorption of toxins from the alimentary canal; hence it is important that the food remnants should be hurried through the intestine at such a rate that there will not be time for putrefaction to take place.

LOCOMOTOR ATAXIA

Much more can be done for this disease than is generally supposed. General light applications two or three

times a week, and especially the arc light to the spine daily, are measures of very great value. The arc light applied to the spine and over the areas subject to lightning pains is a good means of relieving this most distressing symptom. Combined with proper diet and with educative gymnastics, the phototherapy may be relied upon to arrest this disease and in many cases to cause the disappearance of nearly all its characteristic symptoms. The lost reflexes will not return, but excellent co-ordination may be secured so that the gait becomes natural.

EPILEPSY

This disease is by no means so hopeless as it has been commonly regarded to be. Phototherapy combined with an outdoor life, hydrotherapy, and a strict dietary will accomplish wonders in these cases. A vigorous application of the general light bath should be made at least three times weekly. The patient should sweat profusely. After the bath, a vigorous cooling application of some sort should be made. The arc light may be applied to the spine on alternate days. The patient should strictly follow an antitoxic diet, excluding flesh meats of all kinds. It is important to eliminate salt from the dietary. In some cases this regime will cause the prompt and complete disappearance of the paroxysms. In many cases, however, the use of small doses of bromid of potash, five to seven grains three times daily, may be necessary for a few months. By persevering effort, a large proportion of these cases may be restored to permanent health.

HABIT CHOREA

The best light measures are short electric-light baths

two or three times a week, arc light to the spine, outdoor life, educational gymnastics and an antitoxic dietary.

HYSTERIA

All but the most inveterate and degenerative cases will yield to the persevering application of phototherapy and appropriate hydriatic measures. The patient must, of course, be required to comply with all the rules of hygiene in relation to diet, sleep, etc. Tonic electric-light baths may be employed two or three times a week. The arc light should be applied to the spine on the alternate days. Local paralyses are relieved by the arc light, the photophore and the thermophore followed by rubbing. Both sensory and motor paralyses often yield very promptly to these measures. Contractions require prolonged applications of the photophore and the thermophore followed by cold rubbing and massage. Hyperesthesias and paresthesias are relieved by the arc light with the red screen or the photophore. Visceral neuralgias yield to the arc light and the photophore followed by the heating compress. Spinal irritation is best relieved by the application of the arc light in such a way as to produce decided erythema. The hand photophore may be used in these cases with advantage. The intensity of the light should be as great as can possibly be borne, even when the photophore is kept in continual motion.

NEURASTHENIA

There is no disease in which greater benefit may be derived from light appliances than this. In general the application should be tonic in character; that is, short,

suspended as soon as perspiration begins, and followed by carefully graduated cold applications. The arc light accompanied by rubbing of the skin is also an excellent measure. It may be employed daily with advantage. The portal congestion which often exists in these cases may be relieved by the arc light and the photophore to the abdomen followed by ice rubbing and the heating compress. The neuralgias often present in this condition are relieved by local applications of the arc light or the photophore or the thermophore, followed, if necessary, by a cotton pack. The diet should be antitoxic. Yogurt tablets may be used with advantage. Nearly all cases require stimulation of the intestinal activity, as intestinal autointoxication is nearly always present.

MIGRAINE

This disease is generally due to intestinal autointoxication in combination with a special susceptibility or predisposition of the nervous system. Intestinal autointoxication must be combated by an antitoxic diet, discarding flesh foods entirely, by the use of ordinary buttermilk or yogurt buttermilk, yogurt tablets, and especially by stimulating the intestinal activity. There is generally a foul condition of the tongue, and putrid stools are usually encountered in these cases. No permanent relief can be obtained until these conditions are removed. Tonic applications of the electric-light bath may be made two or three times a week. The arc light may be applied to the spine on alternate days. It is well to follow the arc light by vigorous ice rubbing. Applications of the arc light and the photophore to the abdomen followed by ice rubbing, the heating compress, and the wet girdle to be

worn at night, are other measures which may be advantageously used in these cases.

WRITERS' CRAMP

General applications of the electric-light bath should be made for tonic effects. The arc light with ice rubbing should be applied to the spine daily, and the arc light or the photophore should be applied to the arm, followed by cold rubbing and massage and proper gymnastics. During the treatment it is, of course, important that the affected muscles should be allowed complete rest.

MELANCHOLIA

This condition is doubtless due in most cases to chronic toxemia; hence attention must be given to the dietary. It is of special importance that flesh meats should be excluded. Antitoxic foods only should be employed. Buttermilk may be used freely, especially yogurt buttermilk. The free use of prunes is advantageous. Special care should be taken to render the diet as laxative as possible.

The electric-light bath prolonged to the extent of producing vigorous perspiration should be employed two or three times a week. Applications of the arc light to the spine are extremely useful. Tanning the whole surface of the body by means of the arc light will be an excellent means of improving the patient's general vital condition. The portal circulation, which is always sluggish in these cases, may be encouraged by the application of the arc light or of the photophore to the abdomen, followed by ice rubbing and the wet girdle worn at night.

MANIA

It is now recognized that in the majority of cases mania is only a symptom of toxemia. The cause of the autointoxication must be sought and removed. It will generally be found in the intestinal canal. The most effective means of removing the causes of this condition is the regulation of diet. Flesh meats should be discarded. The diet should be strictly antitoxic. Intestinal activity must be encouraged by a laxative diet.

The light baths should be of short duration and should be followed by suitable cooling applications. In cases in which insomnia is a marked symptom, the short electric-light bath followed by a wet sheet pack or a prolonged neutral bath will be found a most effective means of inducing sleep, even when drug hypnotics in all forms have proved ineffective.

Every insane asylum should be supplied with means for applying light in all useful ways. There is no class of maladies in which physiotherapy secures more certain or more happy results than in acute mental disease.

GENERAL PARESIS

Of course there is not much hope of cure in these cases, but by means of phototherapy together with other suitable hygienic and therapeutic measures the disease may in the majority of cases be arrested, at least temporarily, and in many cases a very considerable degree of improvement may be secured. The sweating electric-light bath should be employed two or three times a week. The bath should be followed by a vigorous cold application. The general ice rub is very appropriate, as this measure affords a very excellent means of strong stimulation of the nerve centers. Arc light to the spine, accompanied by ice rubbing, is also a valuable measure. This is a measure which may be employed daily with advantage.

The diet should be strictly antitoxic. The bowels should be made to move freely two or three times daily.

ANEMIC HEADACHE

This symptom attends a great number of conditions which require different modes of procedure. Attention must be given not only to the disturbed circulation, but to the cause of the anemia, which is generally intestinal autointoxication, requiring, of course, an antitoxic diet and careful regulation of the bill of fare. It is especially important to suppress an excess of proteins, and therefore flesh food should be discarded. Buttermilk and especially yogurt buttermilk are particularly to be recommended. Care should be taken to secure frequent and thorough evacuation of the bowels, so as to cause the disappearance of the putrid odor of the stools which is usually present. Short general light applications should be made two or three times a week, and should be followed by mild tonic applications of cold. The arc light may be applied with advantage to the neck and to the scalp. The photophore may with great advantage be applied to the feet and legs at the same time that the arc light is applied to the head.

HYPEREMIC HEADACHE

Cold cloths should be applied to the head and neck while the half electric-light bath is applied to the legs. At the conclusion of the application, the cold-mitten fric-

tion or towel rub should be applied to the legs, or they may even be rubbed with ice. Short applications of the arc light to the spine accompanied by ice rubbing are in many cases serviceable.

SUPRAORBITAL HEADACHE

Apply the photophore to the feet and the arc light or the photophore to the affected part, care being taken to protect the eyes and the rest of the face.

POST-ORBITAL HEADACHE

Apply the photophore to the feet and the arc light to the affected area.

NEURALGIC HEADACHE

Apply the arc light or the photophore to the affected part. General electric-light baths two or three times a week, with the arc light, the photophore or the thermophore to the affected part daily or two or three times a day, as may be required to control the pain, rarely fail of success. The arc light or the photophore should be applied to the abdomen and spine daily, and the wet girdle should be worn at night. A short application of the arc light to the affected side of the head, care being taken to protect the rest of the head, will sometimes afford almost magic relief from distressing pain.

INSOMNIA

A short electric-light bath, followed by a neutral bath for half an hour or the neutral spray for three or four minutes, is a most effective means of relieving insomnia.

In obstinate cases it is well to follow the short electric-light bath by a wet-sheet pack. A prolonged electric-light bath is likely to produce wakefulness by exciting the nervous system unduly. The arc light may be applied to the spine with advantage in the early part of the day. During this application, the feet and legs should be heated by the thermophore or some other efficient means.

CHRONIC BRONCHITIS

This condition is usually symptomatic of chronic toxemia or emphysema. It is always associated with lowered vital resistance. As general tonic measures, applications of light should be made at least three or four times a week, and care should be taken after the bath to cool the patient off properly. The application of arc light to the back and the chest is a most effective means of relieving cough and expectoration. The application should be made of sufficient intensity and duration to produce decided erythema.

CHRONIC PLEURISY

General tonic applications of the electric-light bath should be made together with local applications of the arc light, the photophore, or the thermophore. The arc light and the thermophore are the most effective means because of the penetrating character of the thermic rays. General cold frictions should be employed as a means of increasing vital resistance, and a heating compress should be applied over the chest. When the pain is in the front part of the chest, the arc light should be applied not only over the affected area, but over the whole chest surface, reaching as low as the umbilicus.

FUNCTIONAL HEART DISORDERS

As these affections are usually symptomatic of general disorders of nutrition, they are very certain to yield to suitable applications of the light bath. The general electric-light baths may be employed two or three times a week. They should be short, stopping at the very beginning of perspiration, and care should be taken to protect the heart during the bath by a cold compress or the ice-bag. The arc light followed by ice applications may be used with advantage. Care must be taken to correct faulty digestion and sluggish action of the bowels by regulation of the diet. The antitoxic diet is generally required for permanent relief.

ARTERIOSCLEROSIS

Light applications to the general surface of the body either by the arc light or the incandescent light are of far greater value in arteriosclerosis than any other external measure which can be applied. The effect of the application is to dilate the surface vessels, thus relieving the heart, while at the same time all the functional activities of the body are quickened and thus the cause of the disease is combated. The most thoroughgoing effects are produced by the application of the arc light to successive areas of the skin, going over the whole surface of the body in the course of a week. The intensity of the application should be sufficient to produce a moderate degree of photo-erythema. This permanent dilatation of the vessels greatly relieves the work of the heart in cases of hypertension. The application is of equal value in cases of secondary low pressure, although in these cases the beneficial result will be manifested not in lowering the

pressure, but in increasing cardiac efficiency by lessening the amount of work required of the heart. Not infrequently the improvement is later shown in a preliminary rise of blood-pressure, showing the increase of cardiac energy; but if the treatment is continued, a subsequent fall in blood-pressure occurs as a result of the opening up of the blood-vessels and the oxidation and elimination of the toxins to which the diseased state of the vessels is due. The fall in blood-pressure sometimes occurs within a short time after the beginning of the treatment, doubtless due to the lessening of the toxic products in circulation through the vessels, the presence of which gives rise to spasm of the small vessels through irritation of the vasomotor centers.

CHLOROSIS

This condition is generally due to autointoxication, hence the same measures should be employed as have been elsewhere recommended for relief of this condition. The general electric-light bath is highly beneficial in these cases. It not only relaxes the vessels of the skin, thus relieving the internal congestion, but stimulates oxidation and so promotes the elimination of the waste matters with which the tissues are clogged.

The duration of the bath should be sufficient to induce perspiration. It should be followed by a short, vigorous cold application, such as the towel rub or the half-sheet rub. The application of the arc light in connection with the ice rubbing may be made to the spine with advantage. The arc light or the photophore should be applied over the entire abdominal surface for fifteen or twenty minutes daily. This application should be followed by the

ice rub and the heating compress. An antitoxic diet and free intestinal action are essential measures to be employed in connection with the light treatment.

EXOPTHALMIC GOITER

Tonic general applications of the electric light may be made with advantage every other day. The application of the arc light with ice rubbing should be made to the spine daily.

MYXEDEMA

Vigorous application of the electric-light bath should be made at least three times a week. Profuse perspiration should be induced. There is decided slowing of all the metabolic processes of the body in this condition, and diminished oxidation. A daily application of the electric-light bath may be made if care is taken to employ cooling measures at least half the time, so as to avoid exhaustion of the patient. The arc light with ice rubbing should be applied to the entire spine, and the same application may be made with advantage over the thyroid gland daily. Each general application of light should be followed by a vigorous cold application, such as the cold-towel rub or the half-sheet rub.

CHRONIC RHEUMATISM, ARTHRITIS DEFORMANS, RHEUMATIC GOUT

This disease is without doubt a toxemia resulting from the absorption of toxins and possibly also bacteria from the alimentary canal. The antitoxic diet with free intestinal activity and the use of yogurt tablets and yogurt buttermilk are effective measures for removing the causes of the intestinal autointoxication.

Light baths are of great value as a means of stimulating the skin, eliminating poisons, increasing oxidation and relieving pain. Prolonged sweating baths, however, are likely to debilitate the patient and should be employed only at rare intervals. It is better to conclude the bath as soon as free perspiration is established. Great care must be taken in cooling the patient off. In very feeble patients alcohol rubbing should be employed first; later, the cold-mitten friction, the cold-towel rub, and finally the half-sheet rub may be employed. Radiating pains will be relieved by the application of the arc light and the photophore. The thermophore in some cases answers the purpose nearly as well.

PHOTOTHERAPY IN CHRONIC DISEASE

Holm states that he has applied phototherapy in 350 cases during the last four years and has had very gratifying results. In 265 cases the treatment was required for chronic rheumatism, uric arthritis, chlorosis or anemia.

He has found the action of red light particularly effectual in cutaneous affections, such as the eruption of smallpox, sunburn and psoriasis. The red light seems to have a specific action in inducing sweating.

The chemical rays have a stimulating action on the nervous system and the metabolism. The ultra-violet rays have a further bactericidal effect, while the other chemical rays merely check the development of bacteria. The chemical rays dilate the peripheral blood-vessels and induce inflammation in the skin and pigmentation when the application is intense and prolonged.

Applying treatment on these principles, he has cured inveterate sciatica, gout, chronic rheumatism, etc., as he shows by several instances related in detail. One patient was a man of 42, who had suffered from recurring sciatica for seventeen years, rebellious to all kinds of treatment and frequently compelling him to stay in bed. He was treated with the "combined light bath," temperature up to 65° C. (149° F.), with following douche, alternating every other day with a local light bath along the course of the sciatic nerve. Five weeks of treatment seem to have effected an entire cure.

Holm uses also a full bath with incandescent and arc lights representing 5,000 candle-power and a local light bath for the part affected, which can be applied in the bed, but the combined bath described above has the most powerful effect on the metabolism, although it requires a normal heart and resistant nerves.

All the measures employed by Holm, as well as other clinicians, are modifications of the original light baths, photophores, and other light appliances devised by the author and described in this work.

PHOTOTHERAPY IN DISEASE OF THE JOINTS AND MUSCLES

The arc light is of special service in this class of cases on account of its great intensity, especially when combined with the air blast.

In some cases the thermophore is found equally effective. Muscular cramps are relieved by the photophore and the thermophore. The application should be followed by the heating compress.

Neuralgia of the joints is relieved by the arc light and

the photophore. Enlargement and tenderness of the joints require the vigorous applications of the photophore and the thermophore. These measures are much more effective than the hot-air applications for the reason that the thermic rays penetrate deeply into the tissues, whereas the hot air only heats the surface. Applications to the joints should always be followed by the heating compress or the cotton pack. Most excellent effects are obtained by light applications in these cases.

The results of phototherapy in tubercular disease of the joints are far superior to the Bier's method. A much more intense degree of local hyperemia can be induced than by the application of the elastic bandage, and without any of the risks or inconveniences of the latter method. There is no danger of overdoing the treatment even if the application is carried to the point of producing so-called erythema or photo dermatitis. The most intense leucocytosis is produced, and a durable vascular activity which is most conducive to recovery.

DYSMENORRHEA

This disease is so often associated with conditions of malnutrition that it is quite likely to be relieved by general tonic applications of light. The electric cabinet bath gives satisfactory results. It should be employed two or three times a week, and should be followed by careful tonic applications. The arc light and the photophore may also be applied with great advantage to the lower part of the back and across the lower abdomen.

The most effective of all means of relieving pain during an attack is the thermophore pack. It should be applied in such a way as to include the hips and the legs,

which should be heated very hot. After the pack, the legs should be covered very warm, wrapped snugly with cotton covered with mackintosh, so as to maintain hyperemia of the lower extremities. By this means blood may be diverted from a congested ovary and great relief is experienced.

AMENORRHEA

A short application of the arc light followed by ice rubbing should be made daily between the periods. A day or two before the time for the appearance of the menses the ice should be omitted. The arc light may be applied to the lower spine and the photophore to the legs. At the time for the appearance of the menstrual flow, the thermophore may with advantage be applied to the hips and legs. The application should be continued ten or fifteen minutes. At the conclusion of the application, the surface should be cooled by careful alcohol rubbing. Great care should be taken to avoid chilling the patient. Massage, the outdoor life, especially out-of-door sleeping, and hygienic means necessary for the improvement of the general health, must not be neglected.

CHRONIC METRITIS

The electric-light bath affords most excellent derivative measures for relief of this condition. The photophore, the thermophore and the arc light may be applied to the lower abdomen, the back and the buttocks, as well as to the lower extremities, with great advantage. The half light bath is a most appropriate measure in these cases. If the application is prolonged sufficiently to produce decided erythema of these parts, more definite and permanent results will be produced. The light applications should be followed by a cold-mitten friction or towel rub to fix the blood in the skin. General light applications followed by the salt glow, sheet rub or spray, may ge given two or three times a week with advantage. Vaginal irrigation should be employed daily. It must be remembered, however, that this disease, as all other chronically diseased conditions of a local character, can be permanently cured only by building up the general vital resistance.

CHRONIC OVARITIS

The measures to be employed in this condition are essentially the same as described above for neuritis. When considerable pain is present, great relief may be experienced by the continuous application of the thermophore to the feet and over the ovarian region. The writer's experience has shown that many cases of chronic ovaritis which had been pronounced incurable except by some surgical procedure are readily curable by thorough applications of phototherapy combined with rest and other proper hygienic measures.

CHRONIC PROSTATITIS

Chronic painful conditions of the prostate are relieved by the same measures which have been suggested above for the treatment of metritis. It is important to produce and maintain a hyperemic condition of the lower extremities. A pronounced erythema over the lower part of the back is an excellent measure for relieving the pain of this condition. It is expected, of course, that these

measures will be combined with other suitable therapeutic measures as may be indicated.

SPERMATORRHEA

General tonic applications of electric light followed by the cold rubbing sheet are indicated in this condition. The arc light or the photophore should be applied to the lower spine with ice rubbing during the application.

SYPHILIS

Electric-light baths may be employed with great advantage in the late secondary and the tertiary stages of syphilitic infection. There is no more effective means of producing vigorous alterative effects than the prolonged electric-light bath. The bath may be employed daily, the patient being allowed to sweat profusely every other day. On the alternate days the skin should be cooled by the air current and the degree of heat rendered as intense as possible. By this means employed alone or in connection with suitable medicinal agents, the absorption of gummatous deposits may be effectively promoted.

The local application of the arc light is of great service in necrosis. Local applications of light are generally of service in various complications which develop in the course of this disease.

Several authorities have experimented with the actinic rays in the treatment of syphilitic chancre, gummata and also soft chancre.

According to Berbensi and Strebel, venereal ulcers disappear within a few days under daily exposures, but the secondary eruptions are not prevented. Phototherapy does not seem to benefit the glandular swellings.

SKIN AFFECTIONS

Light is particularly valuable as a means of treating various skin affections, particularly the following:—

Chilblains.—Apply the arc light or the photophore with ice rubbing for five minutes daily, taking care to avoid producing erythema.

Eczema.—This affection is usually accompanied by marked intestinal autointoxication.

The arc light with the red screen may be advantageously applied to the eczematous patches every other day. A portion of the skin may be treated one day, and another portion the next day, until the whole body has been gone over.

In some cases the best results are obtained after the surface has become covered over with dry scales. It is well to apply in connection with the arc light daily cleansing of the parts with resinol soap and distilled water, and the application of the following lotions:

No. 1

Carbolic acid	1 dram
Rose water	3 oz.
Alcohol, q.s. ad.	6 oz.

No. 2

Icthyol	2 drams
Lime water	½ oz.
Oil sweet almonds	½ oz.
Glycerine	4 drams
Rose water	6 drams

The application of No. 1 will relieve the irritation. No. 2 forms a sort of protective antiseptic varnish over the diseased surface.

The good effects of light applications in this disease may be greatly increased by the systematic employment of yogurt tablets, either with or without the use of yogurt buttermilk.

Schamberg has found the actinic ray most valuable in alopecia areata, ulcers, and certain forms of eczema.

Assfalg reports numerous cases of moist and dry eczema which have been cured by the light and dry treatment. Two cases of chronic seborrheic eczema were completely cured after five and eight treatments respectively.

Kromayer recommends the chemical ray in this disease.

Axmann found a ten-minute treatment of acute and weeping eczema to produce so much improvement that on the following day no further treatment was required.

Psoriasis.—The arc light generally succeeds very rapidly in causing the disappearance of this very obstinate eruptive disease. The application should be made with sufficient intensity to produce decided erythema of the skin. The colors will then be reversed—the eruption appearing in the form of white spots on a red ground. In a week or ten days the eruption generally disappears, but it will probably return again unless measures are taken to remove the original causes of the disease, which are generally to be found in an infected condition of the alimentary canal. Care should be taken to regulate the diet so as to cause the disappearance of the putrid odor of the stools. The tongue if coated must become clean, and other symptoms of intestinal autointoxication must be made to disappear. For this a careful antitoxic dietary with the exclusion of flesh foods is essential. Yogurt

tablets should be used at each meal. Yogurt buttermilk may be employed with advantage, and in most cases intestinal activity should be stimulated by the use of Colax and, if necessary, cascara sagrada or Colaxin with laxative foods.

BALDNESS — ALOPECIA AREATA

This condition is generally curable when the scalp is still covered with a fine growth of hair; but if the scalp is smooth and shiny, very little good will result from the treatment. It is often worth while, however, to make a trial. The application should be sufficiently intense to produce decided hyperemia of the scalp or so-called sunburn. The application should be made two or three times a week, and should be continued for several months.

Kromayer, employing an arc light (15 to 25 amperes current) at a distance of four to ten centimeters, exposures one-half to ten minutes for each area, claims most excellent results. He treated thirty-three cases, thirteen mild cases (hair lost on less than half of the head), and twenty severe cases (hair lost more than half or almost completely). The milder cases were nearly all completely cured. A few relapses were induced. Of the twenty cases, fifteen were treated with good results, only five with negative results, and four of the five were cases of total alopecia. Some of these twenty severe cases had lasted for years. In one, a man of fifty, total alopecia had existed for twenty-five years. After twenty-seven treatments the hair was restored to normal, except over the temples, where it was still thin. Kromayer employed an iron electrode without pressure lens.

Finsen noted that the bare arms of nurses giving the

Finsen light treatment showed increased development of hair. This has been repeatedly observed.

Assfalg cured three cases of alopecia areata with an average of fifteen sittings, one-half hour to an hour duration. The cases had lasted for a year and had resisted other treatment.

Axmann reported cures of alopecia under light treatment.

Meyer agrees with Kromayer that fine hair tips begin to be visible after one treatment. In experiments made in order to find out whether light was the exclusive factor, Meyer compared persons treated by the light with those not under treatment. He concluded that the chemical rays are the exclusive factor.

Bang and Helm had good results in the phototherapeutic treatment of alopecia areata.

Finsen reported twenty-nine cases: twenty-two recoveries; one under treatment; six treatment suspended.

Jersild treated six patients, with no relapse.

Noiré treated fifty cases. He found the light treatment most successful when the areas were limited and the skin thin.

Morris treated one case. New hair grew on the areas treated. The regrowth was not permanent.

Sabouraud attributes the effect of the light treatment of alopecia to the local congestion produced.

ACNE

Most brilliant results are always obtainable in this disease. A decided solar erythema should be produced. When the skin peels off, the acne will be found greatly improved. Persevering efforts will effect a cure.

Attention must be given to the diet. Meat and animal fats with the exception of butter must be avoided. The bowels must be moved once or twice daily. The putrid state of the stools which nearly always exists must be corrected by a strict antitoxic diet. The light applications should be made daily or every other day.

Assfalg found acne to be favorably influenced by phototherapy. He prefers light treatment to X-rays. Two patients with acne rosacea were considerably improved with three treatments. One has been cured six months.

Meyer obtained good results in severe cases of acne indurata. The acne nodules under the influence of the hyperemia become reabsorbed.

Loeb reported eight cases treated by means of phototherapy, all of which were cured.

DRUG ADDICTION

The electric-light bath is of very great service in the treatment of the opium habit and all forms of drug addiction. The best method of employing it is the following:—

Employ a quick and thorough sweating electric-light bath daily for three or four days before beginning the withdrawal of the drug. Then withdraw the drug by the rapid method; that is, diminish the dose one-half each day for four or five days. Then drop it altogether. If the amount employed is small, the drug can be dropped at the end of the second day. After beginning the withdrawal of the drug, the sweating bath should be discontinued and instead the photophore or the arc light may be applied to the spine with ice rubbing three or four times daily.

Spinal applications are most excellent means of preventing the collapse and exhaustion which often follows withdrawal of the drug, and especially of preventing the serious heart and bowel disturbances which not infrequently appear in cases of opium addiction in which the drug has been used for a long time and in large quantities. Under light treatment, these symptoms are not very troublesome, and generally, in fact, do not appear at all.

The same principle applies to the treatment of the alcohol habit and other forms of drug addiction.

Great advantage will be found in placing these patients upon a strictly antitoxic diet and in making free use of yogurt buttermilk and of yogurt tablets, the suppression of the formation of toxins in the intestine seeming to have the effect of diminishing greatly the demand upon the narcotic drugs of all sorts.

SPRAINS

Apply the arc light or the photophore to the affected joint and the adjacent portions of the affected limb. Follow by the heating compress. The application should be made two or three times daily and the compress should be worn during the intervals.

POTT'S DISEASE

General tonic applications of light are beneficial as a means of improving the general vital resistance. Strong applications of the arc light or the photophore should be made to the affected portion of the back daily, and the heating compress should be worn during the interval. When considerable pain is present, two or three applications of the arc light or the photophore may be made daily with advantage.

FRACTURES

The pain of fractures may be greatly relieved by the application of the arc light and the photophore. The bandages may be carefully removed for the purpose. Heat may be applied by means of the thermophore without removal of the bandage, and is on this account a safer method when there is danger of displacement of the fragments.

DISLOCATIONS

The pain resulting from the injury to the joint structures which often continues very severe after the reduction of a dislocation may best be relieved by the thermophore, the photophore and the arc light. The application should be followed by rubbing with ice or cloths wrung out of cold water, and the heating compress. The application should be renewed two or three times a day.

VARICOSE AND OTHER CHRONIC ULCERS

The full rays of the arc light are of great value in the treatment of all forms of chronic ulcer. The actinic rays are a most excellent germicide and the thermic rays stimulate leucocytosis and tissue repair as well as phagocytosis. Applications should be made of sufficient intensity and duration to induce solar erythema or sunburn. When erythema occurs, apply boracic acid lotions with cheesecloth compress for two or three days, or until the congestion is allayed; then resume the light applications daily. After healthy granulations appear, the seances

should be less intense and of shorter duration, so as not to overstimulate the newly formed tissue. Recovery is usually very rapid. The patient should avoid much exercise during the period of treatment if the ulcer is upon the leg.

The arc light renders excellent service in cases of sloughing and indolent ulcers of all sorts.

Kromayer recommends the chemical rays in cases of varicose ulcers.

Assfalg reports good results in cases of varicose ulcers with the light treatment.

Axmann treated thirteen cases of leg ulcer. Cures were secured in all the cases after some weeks of treatment. Some of the cases had lasted for years.

So-called varicose ulcer may often be rapidly healed by systematic use of the arc light. The application should be of twelve to fifteen minutes' duration and as intense as the patient can bear. The aim should be to produce very decided reaction. By this means the vascularity of the diseased parts may be greatly increased, and through this means increased reparative activities will be rapidly set in operation.

RODENT ULCER

Malcolm Morris,* in the treatment of rodent ulcer where operation is refused or is impracticable, employs Finsen rays and X-rays separately or combined, and radium. The Finsen rays are indicated when ulceration is not great, and are useful to soften the edge and reduce the number of X-ray exposures. In the ulcerative stage the

* *The X-Ray Treatment of Skin Diseases*, 1907.

X-rays usually give the best results. In six cases of small warty growths in which the clinical diagnosis of rodent ulcer was uncertain, a few applications of Finsen light alone effected a cure.

PULMONARY TUBERCULOSIS

Phototherapy is capable of rendering great service in the treatment of this formidable malady. The out-of-door treatment is now recognized as the most effective method thus far discovered for dealing with pulmonary tuberculosis, and exposure to the sunlight is conceded to be one of the prime factors in the out-of-door method. Purity of air is not sufficient. Many years ago a number of consumptives tried living in the Mammoth Cave, the air of which is pure, cool, and of uniform temperature. They were brought out after a few weeks either dead or corpse-like skeletons. The actinic rays are known to be deadly to the tubercle bacillus, but it is hardly probable that these rays penetrate the body to a sufficient depth to accomplish any material benefit in the destruction of the bacteria in the lungs.

There are numerous observers, however, who have noted the beneficial effects of light, both solar and artificial, in the treatment of phthisis as well as other tubercular affections.

Finsen and his assistants informed the writer that the treatment of lupus was much more successful in the summer than in the winter. Finsen attributed this result to the fact that in summer the treatment was given out-of-doors, so that the patient had the benefit of general exposure to the solar rays.

Sun baths have been observed to be very beneficial in

cases of tubercular disease of the bone and other tissues.

There are those who have claimed remarkable curative effects for the arc light in lung tuberculosis. Good results, if not radically curative effects, are unquestionably to be secured by the use of this potent physiologic measure. The chief clinical applications of phototherapy in this disease from which good results may be confidently expected are the following:—

Either the arc-light bath or the incandescent electric-light bath may be employed.

In the use of the arc light for general effects, either two arc lights may be employed in a cabinet, or by means of the improvised arc-light bath shown in Fig. 8; or a single lamp may be used, making successive exposures of different areas until the whole body surface has been gone over. The exposures should be of brief duration, especially at the beginning. This is especially important with blonds, or light-haired persons, who have thin and sensitive skins, with little pigment protection.

The treatment should be of such a degree of intensity as to produce tanning of the skin, which is accompanied by lasting dilatation of the blood-vessels, thus relieving congestion of the lungs as well as of other important viscera, and so tending to improve the various bodily functions.

These general applications especially improve the blood-making functions, increase oxidation, promote appetite, aid assimilation, and encourage the defensive functions of the body.

It is probable, however, that the chief benefit derived from these applications results from the influence of the more deeply penetrating thermic rays. These energetic

radiations penetrate deeply into the tissues of the whole body. They thus become a powerful means of encouraging all forms of tissue activity. In the diseased lung itself, the thermic rays aid the tissues in their battle against the bacillus by promoting leucocytosis.

It is most important to avoid overheating the patient. On this account it is necessary to combine with the bath the use of the cool-air blast. By this means, as elsewhere shown, the effects of all forms of light applications may be very greatly intensified. The patient should not be allowed to perspire in the bath, and should feel no depressing effects either at the time or later.

The incandescent electric bath is a more convenient and effective means of obtaining thermic effects, but must be carefully used, and is safest in connection with the cool-air blast.

These general light applications should be made at least three times a week, and if short (10 to 15 minutes), may be made daily, or if very short (3 to 5 minutes), twice a day, with the happiest effects. Half-hour exposures may be made with good results if special care is taken to avoid depressing effects from overheating, but only when the cool-air blast is used.

The heart must be protected by an ice bag, a cool compress or a small cooling coil when general applications are prolonged, and when intense applications are made to the chest.

It need scarcely be said that phototherapy is not claimed to be either a panacea or a specific in this disease. It is only one of the numerous effective measures which should be brought to bear with the greatest thoroughness in every case. The out-of-door life day and

night, and careful dietetic management must not be omitted from the therapeutic program of these cases.

LUPUS

The Finsen method with lupus has now been almost wholly superseded by the X-ray method, which has the advantage of far greater rapidity of action, greater certainty and a penetrability much greater than that of the actinic rays. It may still be claimed for the Finsen method that it is effective in cases of superficial infection, that it is perfectly safe, and that it leaves less scar and less deformity than any other method.

It must be remembered, however, that the X-ray does nothing more than destroy the invading parasitic microorganism. It does not improve the patient's resisting power, nor in any other way insure him against a recurrence of the same disease. In this respect the light method offers some advantage.

In cases of extensive tubercular disease of the skin, as well as in cases of tubercular disease of the bone, the writer has adopted and recommends a combined method which seems to possess very practical advantages. This method consists in a combination of the inoculation of Wright with phototherapy. By this plan, rapid and permanent results are attainable. Inoculation raises the tuberculo-opsonic index, while phototherapy builds up the general vital resistance.

Hydrotherapy is of special advantage in these cases in conjunction with phototherapy, although the air bath and the cool-air blast are capable of producing tonic effects almost equal to those of the most powerful hydriatic procedures.

Sequeira, of the London Hospital, states as follows concerning the choice of measures: "For moderate cases of lupus of the skin of the face, Finsen treatment; preceded by X-rays if the surface is ulcerated; preceded by pyrogallic acid or permanganate of potash if warty or fungating.

"For lupus of the mucous membranes, X-rays; if fungating, cautery followed by X-rays.

"For dry areas on the limbs and trunk, excision, and, if necessary, grafting where possible; if ulcerated, X-rays.

"For wide dissemination, probably the best results are to be expected from tuberculin injections, as recently demonstrated by Dr. Wright."

Scholtz is of the opinion that in the Finsen treatment of lupus the chemical rays are absorbed in the superficial layers of the skin, and that the heat rays are responsible for the death of the bacilli in the deeper layers.

LUPUS ERYTHEMATOSUS

This disease depends upon general causes. Local measures alone will not cure. Excision, local caustics, scarifications, scraping, X-rays, and the Finsen treatment all remove local lesions, in some cases replacing the diseased patch by scar, but unless the underlying cause of the disease is treated, recurrence is the rule.

According to Schamberg, however, phototherapy may often be used with the happiest results in this disease. Finsen, Leredde and Pautrier, Morris and Dore, Hyde, Montgomery and Ormsby, and Pusey report favorable results from the use of phototherapy, a number of patients being entirely cured and many partially cured. There

have been some failures and a few have been made worse.

The X-rays are often valuable in the hypertrophic variety, but in the vascular variety they are apt to aggravate the condition.

Pusey says that X-rays and ultra-violet light are occasionally successful, but neither is entirely reliable. Unreliable though they are, however, they form the best means of treatment now at our command. (Pusey, Morris, Schamberg.)

Sabouraud, in the treatment of this disease, combines phototherapy with scarification and galvanopuncture. The actinic ray is safer than the X-ray.

TUBERCULAR GLANDS

The local application of the arc light with the cold-air blast so as to permit the highest degree of intensity possible is indicated in all cases of glandular enlargement. General light applications should be made to raise the general vital resistance.

EPITHELIOMA

Finsen, Petersen, Burgesdorf and others have reported successful arc light treatment of epitheliomata in the early stages. Most authorities, however, prefer treatment with the X-ray for this disease. In fact, Sequeira's experience with all light treatment of epithelioma has been discouraging.

Kromayer recommends the chemical rays produced by the mercury vapor lamp in cases of eczema.

ERYSIPELAS AND SUPPURATING WOUNDS

It was long ago observed that suppurating wounds

heal much more rapidly when freely exposed to light than when covered, and numerous observations have shown the beneficial results of brief exposures of a wound or an infected part to the direct rays of the sun. Both the arc light and the incandescent light may be employed with very great advantage in treating both acute and chronic infections, whether body wounds or of other sorts. Arc light applications to infected or inflamed parts should be of very brief duration in acute cases, but the application should be often repeated. Three or four applications a day of three to five minutes will accomplish much in bringing to resolution a boil, a carbuncle or a dermatitis. Chronic infections require more prolonged applications of the arc light. The duration of the seance should be sufficient to produce a decided reaction. In cases of acute infections, what is desired is simply sufficient stimulation of the circulation to encourage leucocytosis, but the application should not be carried far enough to produce reaction,—that is, a light burn or photo-erythema. In chronic cases, very strong reaction is needed to dilate the vessels and thus increase the blood supply of the diseased parts. By this means, all the reparative activities may be increased, and with rare exceptions rapid healing may be secured.

The incandescent light is likewise serviceable in both acute and chronic infections and inflammations. In acute inflammations, short applications render great service in affording relief from pain. This is secured, not by simple dilatation of the blood-vessels, as has been suggested by some writers, but by a specific inhibitory influence exercised by the thermic rays upon the pain nerves.

In chronic infections, very prolonged applications of the photophore often render very great service, not only in relieving pain, but in hastening the process of resolution. The effect of such an application sometimes decidedly increases hyperemia and swelling at the outside, but the ultimate result is a very marked abbreviation of the inflammatory process. The intensity of the process is increased, but the duration lessened. Prolonged applications of intense heat, as great as can be borne, also exercise a marked controlling effect upon carbuncle in cases in which other remedies have failed of success.

Felons, periostitis and other localized infections lying near the surface may be advantageously treated with either the arc light or the photophore.

Axmann recommends ultra-violet rays in erysipelas and suppurating wounds.

Axmann treated ten cases with ulcers on the body of from six weeks to three years duration. Exposures were half an hour in length. The ulcers all healed in four weeks at the most, from three to eight exposures being made. In one of the recent cases the ulcer healed under the physician's eyes in two exposures.

Axmann found that venous blood after long exposure to the air turns a bright red when exposed to the ultra-violet rays. He believes this effect is due to the nascent ozone generated. He says that fresh and suppurating wounds behaved under the influence of the rays as if they had been swabbed with hydrogen peroxide.

OTITIS MEDIA AND MASTOIDITIS

Acute otitis media, if taken in hand at the outset of the disease, may generally be aborted by the application of either the arc light or the photophore. The duration of the arc light application should be from four to six minutes with an intensity as great as can be tolerated. The application may be repeated three or four times a day. The photophore may be applied continuously for several hours if necessary to afford relief. The same measures are of great value in mastoiditis and will not infrequently obviate the necessity for surgical procedure if applied promptly and in a thoroughgoing way.

Chronic otitis media accompanied by obstinate suppuration may be successfully treated by thoroughgoing applications of the arc light. The duration of the seance should be sufficient to produce decided hyperemia of the ear and surrounding tissues, usually eight to twelve minutes. Several applications may be needed to permanently stop the suppuration. It is well to cleanse the ear and to make free applications of dry boracic acid at the same time.

NEVUS

The deep red color of the disease is lessened by phototherapy. Some cases are entirely cured. (Forchhammer.)

In one case of nevus treated by Petersen, in which the disease extended from the forehead to the eyelid, improvement took place not only in the part of the forehead treated, but also in the part of the nevus on the upper eyelid, which was so situated that it could not be exposed to the light. (Freund.)

HYPERTROPHIC SCARS

Malcolm Morris reports that in all cases of simple hypertrophic scars treated by him there was improve-

ment, and in some it was much greater than could have been anticipated. He mentions especially the treatment of hypertrophic scars following burns. He gave forty-one applications of one hour daily in a case of severe sulphuric acid burn of the face and eyes. The scars were so much reduced that practically all disfigurement was removed.

This method is not successful in removing the scar, but it produces great improvement in the appearance and texture of the cicatrix. He reports in detail one case in which twenty applications were given, three each week, to produce the desired results.

He reports another case in which thirty-four applications were made in a case of hypertrophic cicatricial tissue following an operation for tubercular glands. The elevated parts were reduced in size and thickness, and became flush with the surface, while a deeply depressed scar was almost leveled up. All the scars became less conspicuous.

THE LIGHT TREATMENT OF HAY-FEVER

Hurlimann (*Correspondenz-Blatt fur Schweizer Aertze,* Aug. 1, 1907) reports the successful treatment of two patients suffering from hay-fever by the dry, hot-air method. A photophore or cabinet containing six incandescent electric lamps is placed over the patient's face, his forehead and eyes being protected by a cold compress. The hot air is retained by means of a blanket or other thick cloth thrown over the cabinet. An opening on one side permits the entrance of fresh air. The patients are instructed to take thirty inspirations, breathing the air in through the nose and expiring it through

the mouth, after which the apparatus is removed. The author believes the above treatment could be considerably prolonged without thereby affording any discomfort to the patient.

THE LIGHT TREATMENT OF WOUNDS

The photophore may be used to great advantage as a means of promoting the healing of wounds. Asbeck (*Journal de Med. de Paris,* July, 1907) was one of the first to call attention to the value of heat in promoting the heating process. The wound is dressed with iodoform, sterile gauze and cotton held in place by a bandage. The parts are then exposed to heat from a hot-air furnace, fireplace or stove.

The photophore is a better method of applying heat in these cases, not only because of the greater convenience as a means of heating but because of the penetrating power of luminous heat rays. Asbeck has noted most excellent results from these applications of heat in the promoting of healing of wounds due to traumatisms, especially cases of severe burns.

THE LIGHT TREATMENT OF SOFT CHANCRE

According to C. H. Roger, there are certain viruses which are much more sensitive to heat than the tissues in which they may exist. Thus the investigations of Dr. Aubert show that a temperature of 104° F. is sufficient to check the multiplications of the bacillus of soft chancre. At a temperature of 104° F. the microbe is killed. The hot douche has been successfully used as a means of applying heat in these cases.

The arc light and the photophore afford the most ef-

fective means for raising the temperature of the tissues to the desired degree. The application should be made twice a day. The duration should be eight or ten minutes. By employing the air douche, the intensity of the application may be increased and thus the deeper tissues may be exposed to a higher temperature and more certain results may be secured.

VIII.

Phototherapeutic Appliances

THE increasing popularity of the light bath as a therapeutic means within recent years has led manufacturers of electric light apparatus to put upon the market a considerable variety of appliances all of which are possessed of more or less merit—some more, others less.

A curious but not altogether inexplicable observation in connection with the advertising literature sent out by these various manufacturing concerns is the almost uniform attempt of each one to make himself appear to be the first in the field or the possessor of a monopoly in the shape of some unapproachable and unique feature, together with absolute silence respecting the early history of the electric-light bath, with which the profession of this country is much less familiar than that of Germany and France. The German medical literature of phototherapy gives ample and fair recognition of the fact that the medical use of the incandescent light bath originated at the Battle Creek Sanitarium under the author's supervision. The first applications of the incandescent light for this purpose were made nearly twenty years ago. The mere matter of personal recognition in connection with the therapeutic use of the light bath is, however, not a matter of any particular consequence to the author, whose chief interest is that this valuable therapeutic means should find its principal place in therapeutics, which, indeed, it seems in a fair way to do in the

near future. Indeed, no physiologic method has made such rapid progress within the last ten years as has phototherapy. The interesting and important discoveries and researches of Finsen in relation to the value of the arc light in the treatment of lupus helped to afford a scientific basis for light therapeutics, and the interest developed has led to the application of this wonderful physical agent to a great variety of conditions, in some of which it serves a purpose quite as important and definite as in the treatment of lupus.

Description of the Author's Incandescent Electric-Light Bath

THE UPRIGHT CABINET

In floor dimensions this cabinet is 43 inches square, with a height, including base insulators, of 54 inches. The exterior form is square, while the mirrors of the interior are set in octagonal form, thus giving the strongest possible construction. The lamps are arranged in vertical rows between the mirrors, thus securing the very best dispersion of the light. The woodwork of the cabinet is beautifully finished from quarter-sawed oak and paneled in a very neat design. The eight mirrors of the interior finish are each 13 x 42 inches, excepting the door mirror, which is 15 inches wide, and are of genuine first quality French plate glass.

As little wood as possible is used in the interior construction, and this is heavily coated with fine white enamel so as to present a good reflecting surface. The floor is of hard maple.

The wiring and other electrical construction conforms

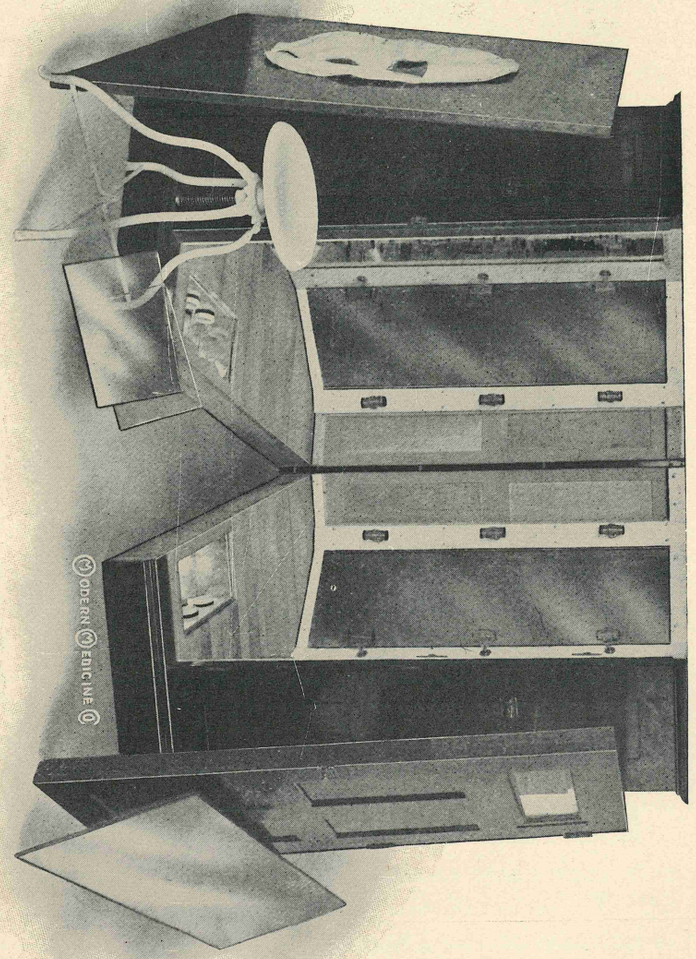

Fig. 63. The Electric Light Bath Cabinet in Sections, showing how the Cabinet may be taken apart to facilitate moving. See page 202.

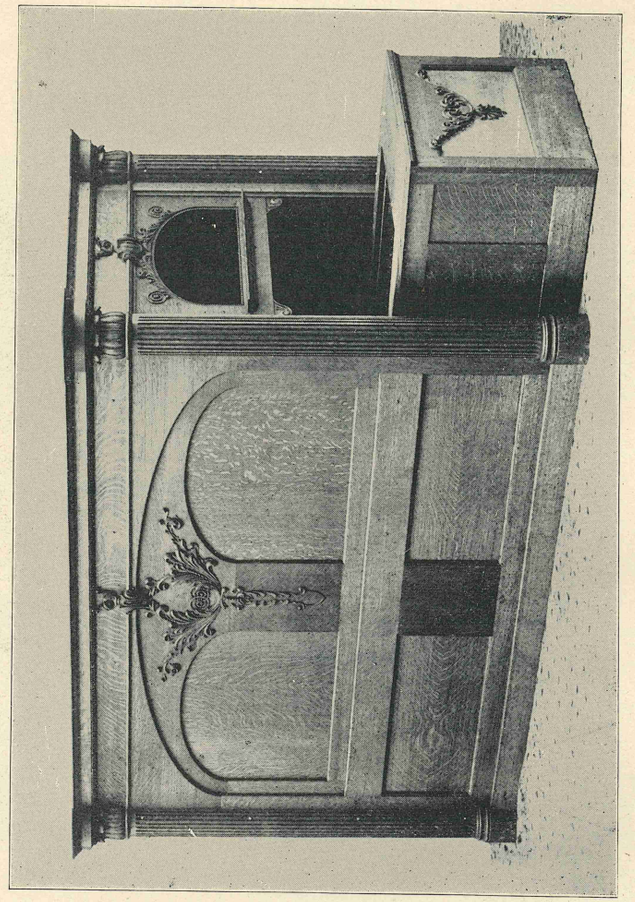

Fig. 64. The Horizontal Cabinet for Electric Light Bath. See page 204.

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to the rules of the Board of Underwriters. The manufacturers are indebted to many inspectors and electrical experts for suggestions in relation to safe and durable construction. All conducting wires are covered with double braid as well as rubber insulation, and when covered in are enclosed in conduits. Thus danger from fire is absolutely eliminated.

The forty-eight lamps of the interior are arranged in eight rows of six each, the lamps themselves being mounted in nickel-plated twin sockets. Each group of lamps is controlled by its own switch. Thus the operator may instantly throw in or out of use any group or all as he may wish, or any desired combination. These switches are conveniently placed in a closed box on the top of the cabinet with a door to open when in use. The fuses or cut-outs are placed in a box at the bottom of the cabinet.

The labor of installing the cabinet is very small indeed. It is only necessary to run the main feed wires through the floor openings and make them fast in the cut-out blocks. Any ordinary electrician can do this in a few minutes.

With each cabinet is supplied fifty incandescent lamps, fuses, and everything ready for operation as soon as the current is supplied, including an adjustable stool with oxidized metal base and oak top.

The cabinet is adjustable to persons of all sizes. The doorway has a clear width of nearly 20 inches. To the circular opening in the top is fitted a canvas covering to fit around the neck of the patient. Every detail is complete and convenient, and the cabinet is in all respects ready for immediate use.

THE HORIZONTAL CABINET

In another form of cabinet provided with 60 to 90 lamps the patient lies in a horizontal position, the lights being placed on three sides. A suitable couch provided with rolls is pushed entirely inside the cabinet or only so far as to expose such portions of the body as it is desired to bring under the influence of radiant light and heat. This rolling couch is provided with a glass top beneath which are placed a series of lamps, and thus the patient's body is surrounded with light rays as in the vertical cabinet.

The general plan of construction, as regards wiring, etc., is the same as in the vertical cabinet. The horizontal cabinet is especially desirable in cases of Bright's disease and other maladies in which there is a tendency to apoplexy, high blood-pressure or arteriosclerosis.

FALSE CLAIMS OF MANUFACTURERS OF LIGHT APPLIANCES

It is naturally expected that the growing interest in phototherapy and the opportunity for exploiting commercially this new idea in therapeutics, should lead a certain class of manufacturers to make exaggerated statements and over-enthusiastic representations with reference to the possibilities of phototherapy in general and of their special form of apparatus in particular. The effect of this must, of course, be to discourage true scientific progress, but the evil is of a character which time and experience will rectify.

In the interests of scientific light therapy, it seems proper, however, that attention should be called to a few of these unscientific representations. Perhaps the most

meretricious and, from a scientific standpoint, unforgivable faults of this character relate to certain apparatus for the use of incandescent lights of high power. These lamps are recommended as a means of utilizing the actinic ray. The absurdity of such a representation is of course apparent to any person who is familiar with the physics of light, but unfortunately the average physician has been so busily engaged in the study of sick stomachs, livers, nerves and other crippled organs that he has quite forgotten his physics, and so is easily victimized by the ingeniously gotten up circulars or the bland platitudes of the traveling salesmen, and thus is led to pay a large sum for a comparatively inexpensive piece of apparatus with the expectation of receiving in his purchase a great deal more than can possibly be realized.

Apparatus of this sort cannot possibly serve any other purpose than as sources of heat. As sources of heat they are useful only to the extent that the heat furnished can be used in practical applications to the patient. A fifty-candle power lamp will furnish more heat than can possibly be tolerated by the skin when spread over a square foot of the body surface and at a distance of twelve inches from the skin. What useful object, then, can possibly be attained by multiplying 50 by 10? If a 500-candle power lamp is employed, means must be taken to protect the skin from the great excess of heat supplied. If this is done by means of a glass screen or by any other means, it must be evident that the surplus heat is simply wasted. In other words, the physician who utilizes such a lamp is using for lighting his lamp ten times as much current as he is using in the treatment

of his patient. All the results realized could be obtained just as easily with a fifty-candle power lamp, or possibly even with a lamp of thirty-two candle power. Such a lamp provided with a proper reflector at an expense of three to ten dollars will furnish just as effective a therapeutic apparatus as a lamp costing ten times as much. It is evident, then, that the high-power lamp is pressed into service for selling purposes only, to furnish a good talking point, and not because it possesses real practical value.

The *Journal of the American Medical Association* and other competent authorities have called attention to the fraudulent character of these and other representations which have been made in connection with light apparatus; but the manufacturers have not yet turned from their evil ways. The *Journal of the Americal Medical Association,* April 17, 1906, page 1049, says editorially:—

"Practically all the so-called therapeutic lamps are incandescent lamps. The incandescent electric light contains almost no actinic rays, and the only effect that is had from it is from the application of heat. It is hard to see what basis there can be for the extravagant claims made for its therapeutic value."

In selecting such an apparatus, it must always be kept in mind that it is the light that does the work and not the apparatus. As a matter of fact, the chief points to be considered in an apparatus are convenience, efficiency, safety and economy. Any apparatus which meets these several requirements to a reasonable degree will be a good investment.

The specific descriptions of apparatus in this book have been confined to those which have been made under

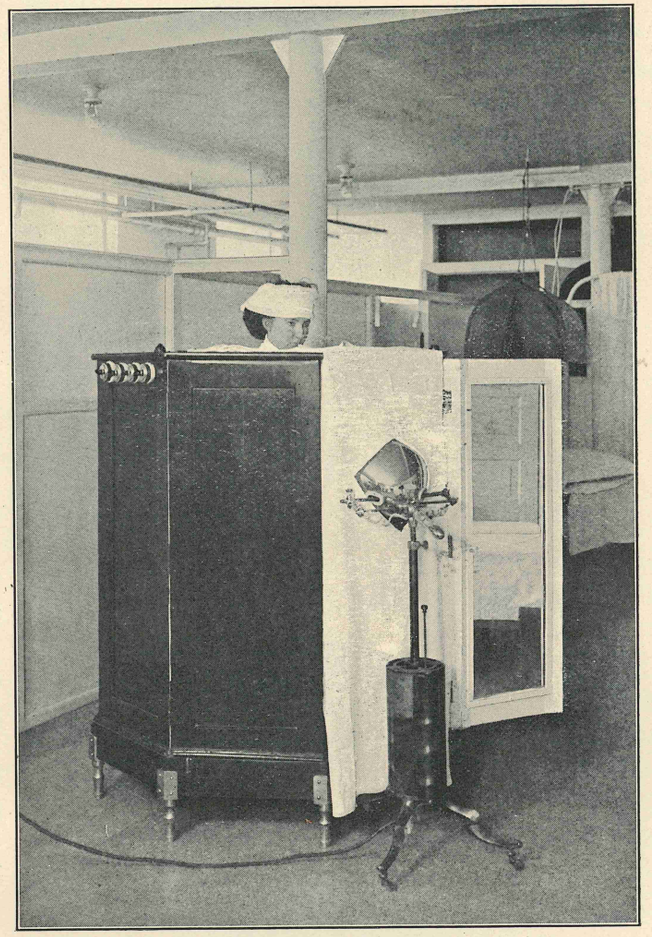


Fig. 65. Combined Electric Light and Arc Light Bath. See page 121.

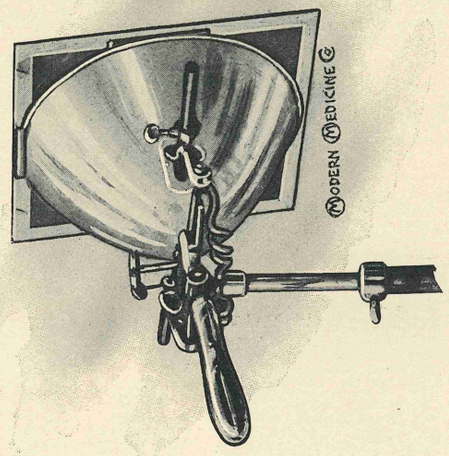


Fig. 67. Showing Color Screen Attached.

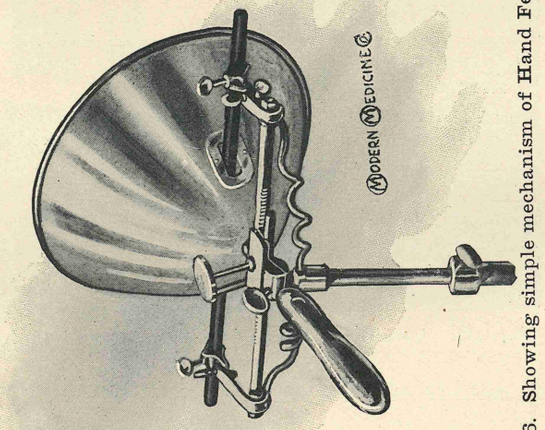


Fig. 66. Showing simple mechanism of Hand Feed.

Figs. 66, 67. The Solar Therapeutic Arc Lamp. See page 207.

the authors' direction, not because these are the only ones to be commended as trustworthy, but because one of the author's purposes in the preparation of this little volume has been to make a record of his work and experience as a pioneer in this branch of physiotherapeutics.

Suggestions for Operating the Solar Therapeutic Lamp

The Solar Therapeutic Lamp is essentially an arc lamp. It differs from the ordinary arc lamp in having:

(1) An adjustable rheostat.
(2) A means for manual adjustment of the carbons.
(3) A parabolic reflector.

THE RHEOSTAT

A rheostat is a device which introduces resistance and thus provides a means for regulating the rate of flow of the current or the amperage. When the vertical rod at the side of the rheostat is lowered so that the knob is at a level with the top of the rheostat, the resistance is maximum and the current is minimum, approximately three amperes at 110 volts. When the rod is raised as far as possible the resistance is minimum and the current is maximum, approximately ten amperes. These figures are only true for 110-volt current and will be higher for higher voltages. The regular rheostat is adapted to voltages from 100 to 125. For higher voltages an auxiliary rheostat must be used.

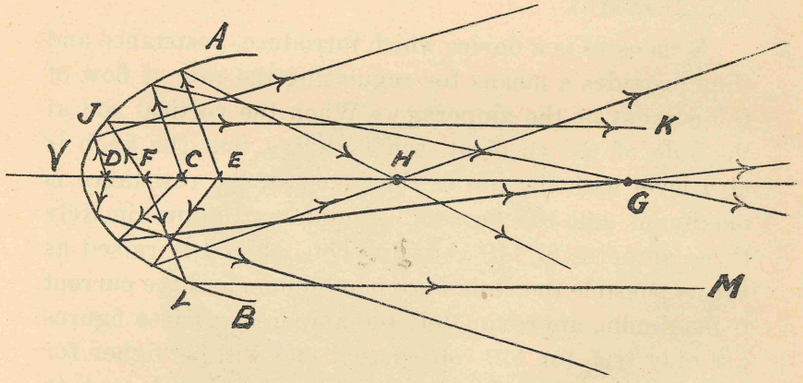
THE MANUAL CARBON FEED

The advantages of our manual carbon feed are twofold: First, by its use a longer arc can be obtained for

the same current than is possible with the automatic magnet-fed lamps, thereby securing a light of greater luminosity and a greater percentage of violet and ultra-violet rays. Secondly, a febrile joint in the carbon holder permits the carbons to be tilted forward or backward, causing convergence or divergence of the rays, as may be desired.

THE PARABOLIC REFLECTOR

The parabolic reflector, with which the Solar Therapeutic Lamp is provided, has many important advantages, as will be readily understood by a careful study of the accompanying diagram.



Let A V B be a plane section of a parabolic mirror through its axis V C G, F is principal focus, and V its vertex, and let us consider three cases in which the light sources are respectively (a) at the focus, (b) in front of the focus, and (c) behind the focus.

(a) If a point source of light be placed at the focus

F, each ray after reflection from the mirror will take a path parallel to the axis; hence all the rays will be parallel to one another. This is the principle utilized in search lights. Theoretically, the intensity of such a light, neglecting absorption, is as great fifty feet from the light source as ten feet away, but practically it is not so, as the light source is not a point.

(b) If the light source be moved to any position (C) on the axis in front of and not very far from the focus F, the rays after reflecting will converge to some point (G) on the axis; beyond G, the rays will diverge with the same angle at which they converge. Hence at G, the secondary focus, may be obtained the brightest light, which diminishes in intensity in either direction from G. But if the light be moved still farther to the front, say to a position E, the angle of convergence is increased, the rays meeting at H, a point nearer to V than G.

In use, whenever a light of great intensity is desired, it may be attained by tilting the carbons forward, in front of the focus F, and placing the patient at the point of convergence of the rays. If the carbons are tilted too far forward, the rays will converge too near the light source for convenient use.

(c) By placing the light source at D, any point on the axis behind the focus F, the rays after reflection become divergent, the degree of divergence being dependent upon the nearness of the light to the vertex of the reflector; the nearer the light, the greater the divergence. This adjustment may be found useful when it is desired to obtain only very superficial actinic ray effects. Divergent rays have little penetrating power, hence should

not be used when the deep effects of luminous heat rays are desired.

THE OPTICAL INTENSITY

The intensity of the light produced by the solar lamp will, of course, depend upon the amount of current and the adjustment of the carbons. The more current the more light, and the greater the length of the arc, that is, the greater the distance between the carbons, the more intense will be the light and the greater the proportion of the ultra-violet rays. In use, the carbons should always be drawn as far apart as possible without producing an unsteady light. With a minimum amount of current, three amperes, the light produced has a brilliancy of about 300 candle power. The maximum intensity, with a current of 110 volts and 10 amperes, is fully 4,000 candle power.

THE CARBONS—THEIR ADJUSTMENTS AND USE

Either cored or solid carbons may be used. Cored carbons give the best results. Small carbons (three-eighths inch) give a more intense and penetrating light than larger ones.

In setting the carbons it is important that the point of meeting should be exactly in the axis of the reflector. When adjustments are not exact the luminous area formed upon an even surface at right angles with the mirror will be irregular or oblong instead of circular, as when the adjustment is perfect.

A set of carbons lasts for ten or fifteen hours in constant use. Half-inch carbons, which answer very well for ordinary purposes, may be obtained from any lighting company for a few cents a pair. Projector carbons, such as are used for stereopticons, are of especially fine quality.

COLORED SCREENS

Colored glass permits the passage only of rays of its own color, absorbing other rays; that is, blue glass permits the passage of blue and violet rays, but excludes the red, yellow and other rays, including most of the luminous heat rays. The red or yellow screen in the same way excludes the actinic rays, permitting the passage of the luminous heat rays. Ordinary glass of any sort absorbs most of the ultra-violet rays, which are invisible. Quartz glass alone permits the passage of the ultra-violet rays. The blue screen is useful in cases in which it is desirable to obtain the effects of the actinic rays without the heat rays. The red screen is used when the effect of the luminous heat rays is desired without the actinic rays. For most cases the light of the electric arc may be used to best advantage without screens.

ELECTRIC FUSES

The purpose of the fuse is to prevent the passage of so great an amount of current as to injure the apparatus or do other harm. The fuse consists of a short piece of metal which readily melts when heated. For the Solar Therapeutic Lamp a ten-ampere fuse is employed at the lamp, while a fifteen-ampere fuse should be used at the meter of the same circuit. In installing care should be taken to see that the fuse of the circuit in which the lamp is placed is of sufficient capacity to furnish the required amount of current.

CARE OF THE PARABOLIC REFLECTOR

When polishing the reflector, use soft cotton flannel with the finest quality of metal polish or Spanish whiting. The whiting may be applied with a wet cloth and allowed to dry, after which the polishing is done, care being taken to rub from the rim to the center and back, never in a circular direction. A can of good polish is sent with each lamp.

CAUTIONS

1. Before attempting to replace or adjust carbons, be sure to open the switch so as to turn off the current.

2. In starting the lamp begin with the minimum amount of current and gradually increase.

3. After turning on the current bring the carbons together so they touch; then separate until the arc breaks; then bring the carbons together again and separate not quite so far as before, or as far as possible without breaking the arc.

4. Gradually increase the current, at the same time separating the carbons until the arc furnishes the amount of light required.

5. Be very careful never to leave the carbons in contact when the current is turned on. This short-circuits the current and is liable to melt or "blow" the fuse.

6. The lamp may be operated by the current obtained from an ordinary Edison socket, but care must be taken to open the switch before screwing the plug in. The current should be on the socket, to insure which it is a good plan to screw out the incandescent lamp while the current is on and the lamp burning. In turning off the

current, open the switch. Do not undertake to turn the current off at the socket, for if this is done the socket is likely to burn out.

7. Before setting up a lamp for permanent use make sure that the wiring of the circuit with which it is to be connected is sufficiently heavy to carry the full amount of current required, otherwise inconvenience will be experienced from blowing out of fuses.

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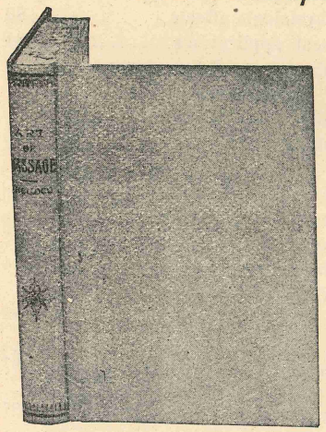

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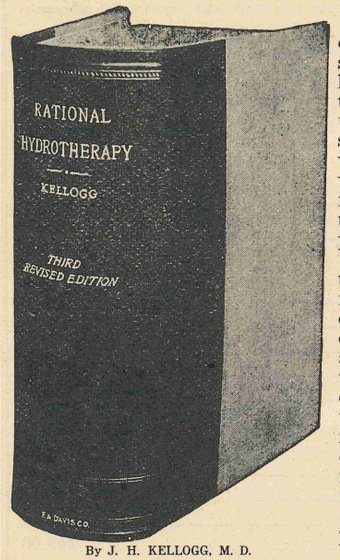

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Therapeutic Appliances

The natural healing agencies now coming into favor, far from being new or faddish, are the oldest curative methods known to man. They have won their way into modern medicine under the name of "Physiotherapy" or "The Physiologic Method," and within a very few years have justified themselves as the most powerful and serviceable measures within the reach of the modern physician.

Emphasis must be laid on the fact that in a properly equipped Sanitarium or Physician's office, all of these therapeutic agencies are needed and all are operated in co-operative harmony. One agency may be more important than another, but each has its own special value, which should be appreciated and turned to use. To the physician who would give his fellowmen the full benefit of the New Therapeutics, the necessary apparatus is an important feature. All of the appliances mentioned below represent the latest model apparatus, designed or perfected at the Battle Creek Sanitarium, where the new system of physiologic therapeutics is more completely represented than anywhere else in the world.

The Good Health Publishing Co. are the exclusive manufacturers of this apparatus for the general trade, and accordingly offer the only means by which this comparatively new system of therapeutics, in its perfected form, can be put into scientific operation in other institutions, offices and homes. These appliances cover the whole range of this curative system. They comprise a complete armament for fighting disease in the most scientific and effective way. Clinical evidence and scientific data, known to every up-to-date physician, have proved this to be the most powerful array of devices ever assembled for combating disease and keeping it at bay.

Solar Therapeutic Arc Lamp	$ 65.00
Thermotherapeutic Lamp	25.00
Electric Light Bath Cabinet	250.00
Photophore	$3.50 to 6.00
Thermophore	6.00 to 8.00
Thermophore Blanket	20.00
Sinusoidal Apparatus	80.00
Sinusoidal and Galvanic	$110.00 to 120.00
Percussion Apparatus	150.00
Kellogg Douche Apparatus	225.00
Home Douche	100.00
Trunk-Shaking Apparatus	150.00
Universal Dynamometer	150.00
Vibrating Bar	100.00
Vibratory Chair	150.00
Centrifugal Vibrator	30.00
Mechanical Diet Indicator	25.00
Kneading Apparatus	150.00
Massage Table	25.00

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LIGHT THERAPEUTICS

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